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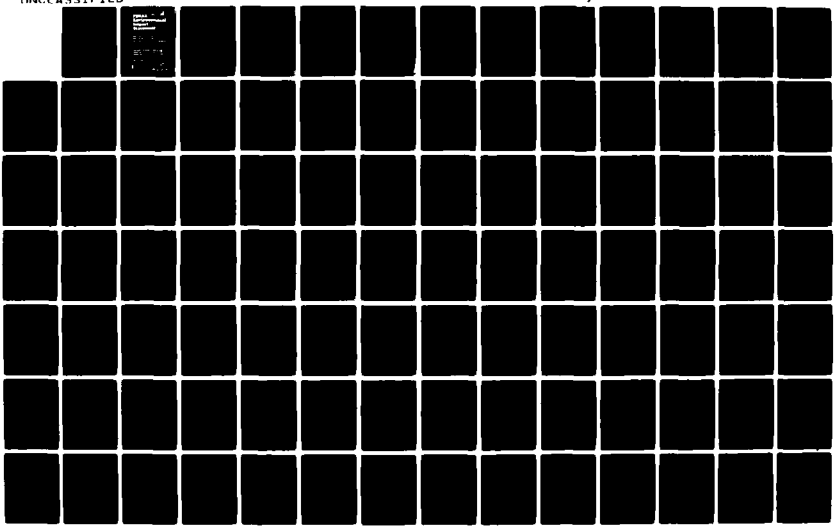

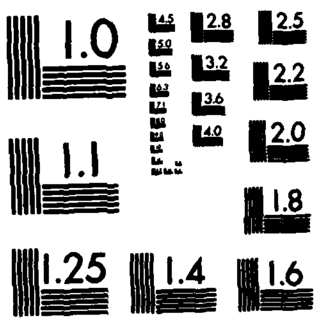
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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A121454	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) FINAL ENVIRONMENTAL IMPACT STATEMENT (PRELIMINARY) POWER PLANT DISCHARGE STRUCTURE, DELTA STABILIZATION DIKE, AND ON-LAND TACONITE TAILINGS DISPOSAL, RESERVE MINING COMPANY, SILVER BAY, LAKE COUNTY, MINNESOTA		5. TYPE OF REPORT & PERIOD COVERED Final EIS (Preliminary)
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Paul 1135 U.S. Post Office and Custom House St. Paul, MN 55101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE March 1977
		13. NUMBER OF PAGES 293
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Environmental impact statements
Reserve Mining Company
Fibers
Tailings

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Reserve Mining Company proposes to install a heated water discharge structure in Lake Superior. This structure would enable Reserve's Lakeside Power Plant to discharge approximately 106,000 gpm of Δ T12°F cooling water into Lake Superior. The delta stabilization dike would be an attempt to stabilize the tailings delta at Silver Bay and prevent the further release of fibers into Lake Superior. Reserve proposes to modify its existing taconite operation to convert from in-lake to on-land disposal of taconite tailings. This would

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require modification to Reserve's Silver Bay plant, construction of dams to form the tailings disposal basin, construction of rail and truck access into the basin area, and construction of a pipeline to transport the tailings to the tailings basin. The project life is projected at 40 years. Implementation of the proposed action would allow Reserve to continue the production of iron ore pellets at about the same rate as at present. The features of the disposal area have been designated to minimize the air and water quality degradation as much as possible. The implementation of the proposed cooling water discharge plan would have minor, localized impacts upon planktonic organisms in Lake Superior. Construction and implementation of the on-land tailings disposal plan would result in the total loss of 9.7 miles of cold-water streams with degradation of additional stream miles from siltation and channelizing. Uncollected seepage of 180 gpm would carry precipitable solids and possibly fibers into the groundwater. About 5,850 acres of terrestrial habitat would be destroyed along with most of the wildlife. The productivity of the land in the basin would be destroyed and could not be fully restored even with reclamation after the end of the project.

PRELIMINARY

FINAL
ENVIRONMENTAL IMPACT STATEMENT

POWER PLANT DISCHARGE STRUCTURE,
DELTA STABILIATION DIKE, AND
ON-LAND TACONITE TAILINGS DISPOSAL

RESERVE MINING COMPANY
SILVER BAY, LAKE COUNTY, MINNESOTA

U.S. DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
1135 U.S. POST OFFICE AND
CUSTOM HOUSE
ST. PAUL, MINNESOTA 55101

MARCH 1977

FOREWORD

This final statement considers the environmental impacts associated with authorization of Federal permits necessary to install a power plant cooling water discharge pipe; to stabilize a taconite tailings delta on Lake Superior; and to develop an on-land taconite tailings disposal area, as proposed by Reserve Mining Company at Silver Bay, Lake County, Minnesota.

After receipt of the Reserve Mining Company permit applications, public notices were issued which described the proposed activities and requested comments from agencies and the interested public on the pending permits. These public notices offered an opportunity to recommend any appropriate conditions that should be placed on these permits should they be granted, and the opportunity to request a public hearing.

Upon evaluation of the Reserve Mining Company permit applications and information submitted therewith, the District Engineer determined that the proposed project would have significant impacts upon the human environment. Therefore, a draft environmental impact statement (EIS) was prepared by the St. Paul District, Corps of Engineers and circulated to Federal, State and local agencies and interested groups and individuals, who were invited to comment on the draft statement.

After receipt and consideration of comments on the draft statement, the Corps prepared this final environmental statement, which includes a discussion of questions and objections raised by the comments, and final analysis of the environmental effects of the facility and the alternatives available for reducing or avoiding adverse environmental effects. It also treats the environmental, economic, social, and other benefits of the proposed activities.

Each of the parties commenting on the draft EIS and receiving the final EIS, or those commenting on the above mentioned public notices, will receive another public notice or clarifying statement regarding final disposition of the Corps permit actions. It is presently anticipated that a final decision with respect to these and other matters pertaining to the applicant's permit request will not be made until resolution of the current State of Minnesota/Reserve Mining impasse.

This final EIS was prepared in response to the requirements of the National Environmental Policy Act of 1969 (NEPA). It was prepared in accordance with the requirements of the Department of the Army, Engineers Regulation 1105-2-507 dated 15 April 1974 and Council for Environmental Quality (CEQ) guidelines dated 1 August 1973.

The NEPA states, in part, that it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may:

Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.

Assure for all Americans safe, healthful, productive and aesthetically and culturally pleasing surroundings.

Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences.

Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice.

Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities.

Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Further, with respect to major Federal actions significantly affecting the quality of the human environment, Section 102(2)(c) of the NEPA calls for preparation of a detailed statement on:

(i) The environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of the human environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Pursuant to regulation ER1105-2-507, the Department of Army, Corps of Engineers, has prepared this detailed statement on the foregoing considerations with respect to its assignment in determining whether Federal permits should be granted to allow implementation of the proposed activities.

SUMMARY

ENVIRONMENTAL IMPACT STATEMENT

PROPOSED POWER PLANT DISCHARGE STRUCTURE, DELTA STABILIZATION DIKE, AND ON-LAND TACONITE TAILINGS DISPOSAL SITE

RESERVE MINING COMPANY

SILVER BAY, LAKE COUNTY, MINNESOTA

( ) Draft (X) Final Environmental Statement

1. Name of Action: (X) Administrative ( ) Legislative

2. Description of Action: Reserve Mining Company proposes to install a heated water discharge structure in Lake Superior. This structure would enable Reserve's Lakeside Power Plant to discharge approximately 106,000 gpm of Δ T12°F cooling water into Lake Superior. The delta stabilization dike would be an attempt to stabilize the tailings delta at Silver Bay and prevent the further release of fibers into Lake Superior. Reserve proposes to modify its existing taconite operation to convert from in-lake to on-land disposal of taconite tailings. This would require modification to Reserve's Silver Bay plant, construction of dams to form the tailings disposal basin, construction of rail and truck access into the basin area, and construction of a pipeline to transport the tailings to the tailings basin. The project life is projected at 40 years.

3. a. Environmental Impacts: Implementation of the proposed action would allow Reserve to continue the production of iron ore pellets at about the same rate as at present. The features of the disposal area have been designed to minimize the air and water quality degradation as much as possible. The primary benefits associated with the continued operation of Reserve are economic in nature, through employment and tax revenues. Reserve's production accounts for approximatley 12 percent of the annual domestic iron ore production in the United States. The cessation of in-land disposal would improve the water quality of Lake Superior by removing the source of fibers now being discharged into the lake. This would aid in reducing the existing health hazard from the waterborne fibers as decreed by the Eighth U.S. Circuit Court of Appeals.

b. Adverse Environmental Effects: The implementation of the proposed cooling water discharge plan would have minor, localized impacts upon planktonic organisms in Lake Superior. Construction and implementation of the on-land tailings disposal plan would result in the total loss of 9.7 miles of cold-water streams with degradation of additional stream miles from siltation and channelizing.

Uncollected seepage of 180 gpm from the disposal area would carry precipitable solids and possibly fibers into the groundwater. About 5,850 acres of terrestrial habitat would be destroyed along with most of the wildlife using this habitat, which is presently of moderate quality for game species. About 4,420 acres of public land would be used along with 3.9 miles of State designated recreational trails and 8.1 miles of nondesignated recreational trails. The recreational value of nearby park and recreation areas could be diminished. There would be particulate and fiber emissions from the basin, constituting a health risk to the residents of the area. There would be an increase in noise levels surrounding the disposal site but no structures exist in the area that would be affected. Energy in the form of hydrocarbon fuels would continue to be expended in the production of the iron ore product. The productivity of the land in the basin would be destroyed and could not be fully restored even with reclamation after the end of the project.

4. Alternatives to the Proposed Action: Alternatives to the proposed plan include:

a. Cooling Tower
b. Alternative Location for Discharge Structure
c. Alternative Discharge Procedure
d. Alternative Intake Structure Location
e. No Delta Stabilization
f. Alternate Sites for On-Land Tailing Disposal
   (1) Embarrass Site
   (2) Colvin Site
   (3) Snowshoe Site
   (4) Midway Site

5. a. Comments Requested: For a list of those Federal, State and local agencies, and citizen and environmental groups from whom comments on the draft statement were requested, refer to Section 9.

b. For a list of those who provided comments, see page 153.

6. a. Draft Statement to CEQ 16 April 1976.
   b. Final Statement to CEQ

FINAL
ENVIRONMENTAL IMPACT STATEMENT
PROPOSED POWER PLANT DISCHARGE STRUCTURE, DELTA
STABILIZATION DIKE AND ON-LAND TACONITE
TAILINGS DISPOSAL SITE
RESERVE MINING COMPANY
SILVER BAY, LAKE COUNTY, MINNESOTA

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AND ON-LAND TACONITE TAILINGS DISPOSAL SITE
RESERVE MINING COMPANY
SILVER BAY, LAKE COUNTY, MINNESOTA

INTRODUCTION

The purpose of this statement is to assess the environmental impacts associated with three interrelated proposals by Reserve Mining Company that require Department of the Army permits. Reserve proposes to install a heated water discharge structure in Lake Superior; to stabilize the tailings delta at Silver Bay with a mine rock dike; and to establish an on-land disposal site for taconite tailings (Mile Post 7).

1.000 PROJECT DESCRIPTION

BACKGROUND

1.001 Reserve Mining Company has been processing taconite ore to produce iron pellets at Silver Bay, Minnesota, since 1955. Reserve is jointly owned by Armco Steel Corporation of Middletown, Ohio, and Republic Steel Corporation of Cleveland, Ohio. Reserve iron pellets presently supply about one-half of the total iron units processed by the parent companies, Armco and Republic.

1.002 Reserve currently mines about 30 million long tons of crude taconite ore annually at Reserve's open pit mine located in northeastern Minnesota near Babbitt. The taconite is hauled by rail 47 miles to processing facilities at Silver Bay, Minnesota, which is on the north shore of Lake Superior. These processing facilities have an annual production capacity of 10.7 million long tons of iron pellets. The pellets are shipped on the Great Lakes from Silver Bay to lower lake ports and then hauled by rail to Armco's and Republic's steel mills.

1.003 In 1955, Reserve was the first mining company to place in operation large scale, commercial mining and processing facilities to produce iron pellets. These pellets are tailor-made blast furnace feed for making iron in steel mills. The waste product, called tailings, from Reserve's Silver Bay processing facilities have been and are presently discharged into Lake Superior at the rate of 21 million long tons annually or 64,400 long tons daily.

1.004 This tailings discharge into Lake Superior has been the subject of concern and criticism since the original permits were granted by the State of Minnesota and the Corps of Engineers. Since 1969, when the U.S. Secretary of the Interior convened the Lake Superior Enforcement Conference, the tailings discharge into Lake Superior and particulate emission into the air from Reserve's Silver Bay processing facilities have been the subject of extensive public debate, administrative proceedings, and court litigation.

1.005 On 20 April 1974, the U.S. District Court for the District of Minnesota held that Reserve Mining Company's discharges of tailings into Lake Superior and particulate matter into the air at Silver Bay, Minnesota, contained fibers that endangered the health of people exposed to the discharges (U.S. vs. Reserve Mining Co. 380 F. Supp. 11 (D. Minn. 1974)). The U.S. District Court ordered an immediate halt to the discharges.

1.006 The U.S. Court of Appeals postponed the U.S. District Court's closure order until it could render a decision on the appeal of the matter after a full hearing (Reserve Mining Co. vs. U.S. 498 F. 2d. 1073 (8th Cir. 1974)). On 14 March 1975, the U.S. Court of Appeals held that Reserve Mining Company's discharges constituted a potential hazard to public health and ordered abatement of the discharges (U.S. vs. Reserve Mining Co. 514 F. 2d. 492 (8th Cir. 1975)).

1.007 An important aspect of the opinion handed down by the Eighth Circuit Court of Appeals on 14 March 1975 concerns the relative importance of the air and water discharges. The court considers the discharge of fibers into the air a hazard of greater significance than the discharge of such fibers into the water. This is stated in the court's opinion at 498 F. 2d 1073 at 500 and at 539 and at 7 ERC 1618 at 1621 and 1650.

1.008 The U.S. Court of Appeals ruled that the decision on the location of an on-land tailings disposal site was to be governed by the laws and administrative procedures of the State of Minnesota. It further suggested that the selection of an on-land disposal site, if one could be found which was mutually acceptable to Minnesota and Reserve, be accomplished within one year. The U.S. Court of Appeals stated that if no acceptable site could be found, Reserve Mining Company would have one additional year in which to close its Silver Bay facilities.

1.009 Since 1969, Reserve Mining Company, the Federal government and the State of Minnesota have investigated numerous alternatives to the present disposal of taconite tailings in Lake Superior. One of the alternatives studied was a disposal site near Mile Post 7 of Reserve Mining Company's railroad, approximately five miles southwest of Silver Bay. Before the U.S. Court of Appeals decision, Reserve Mining Company, in November 1974, submitted applications to the Minnesota Department of Natural Resources (DNR), and the Minnesota Pollution Control Agency (MPCA) for permits to construct an on-land tailings disposal facility at the Mile Post 7 site.

1.010 At present, the Lakeside Power Plant at the Reserve plant in Silver Bay provides the power necessary for the Reserve taconite processing operations. All water used in the Lakeside plant (primarily once-through cooling water) is discharged into a sump. There it combines with Lake Superior water being pumped into the taconite beneficiation plant for use in the ore concentrating process. The water is then eventually discharged back into Lake Superior with the taconite tailings.

1.011 The change to an on-land disposal program for taconite tailings, using recycled water for the concentrating process, would necessitate modification of the present practice for discharging water from the power plant. This modification would be necessary regardless of the location of the on-land disposal site.

1.012 On 18 March 1975, Reserve submitted a completed permit application to the St. Paul District, Corps of Engineers, for construction of a diffuser and heated water discharge pipe (application number LS-192A) to facilitate the discharge of once-through cooling water from the Lakeside plant into Lake Superior. On the same date Reserve submitted an application to construct a breakwater (application number LS-192B) to stabilize the tailings delta after the proposed switch to on-land disposal of the tailings is completed. Both applications come under the purview of Section 10 of the River and Harbor Act approved 3 March 1899 (30 Stat. 1151; 33 U.S.C. 403) and Section 404 of the Federal Water Pollution Control Act as Amended, 1972 (PL 92-500, 86 Stat. 816; 33 U.S.C. 1344).

1.013 On 25 July 1975 the Corps of Engineers published new regulations in the Federal Register concerning the expansion of Corps authority under Section 404 of PL 92-500. The expansion of this authority is phased, with phase I beginning 25 July 1975, phase II beginning 1 July 1976, and phase III beginning 1 July 1977. As of 1 July 1977 Reserve would be required to obtain a Department of the Army permit from the Corps to develop their proposed Mile Post 7 tailings disposal basin.

1.014 On 2 February 1976 Reserve submitted 26 completed permit applications to the St. Paul District, Corps of Engineers, for the following:

4 Diversion Channels
3 Diversion Dikes and Dams
4 Main Dams for the Tailings Disposal Area
3 Seepage Recovery Dams
3 Rail Spur Crossings
6 Construction Road Crossings
1 Pipeline and Road Crossing
Disposal Area for Coarse Tailings
Disposal Area for Fine Tailings

These applications come under the purview of Section 404 of Public Law 92-500. The proposed actions would be necessary for Reserve to establish an on-land tailings disposal basin at the Mile Post 7 site.

1.015 The Minnesota DNR and the MPCA held extensive hearings on Reserve's permit applications from 2 June 1975 through 15 April 1976. On 26 May 1976 the State-appointed hearing officer submitted his findings, conclusions, and recommendations. The hearing officer's final recommendation was: "The Midway alternative is the most feasible and prudent for on-land disposal of Reserve's tailings."

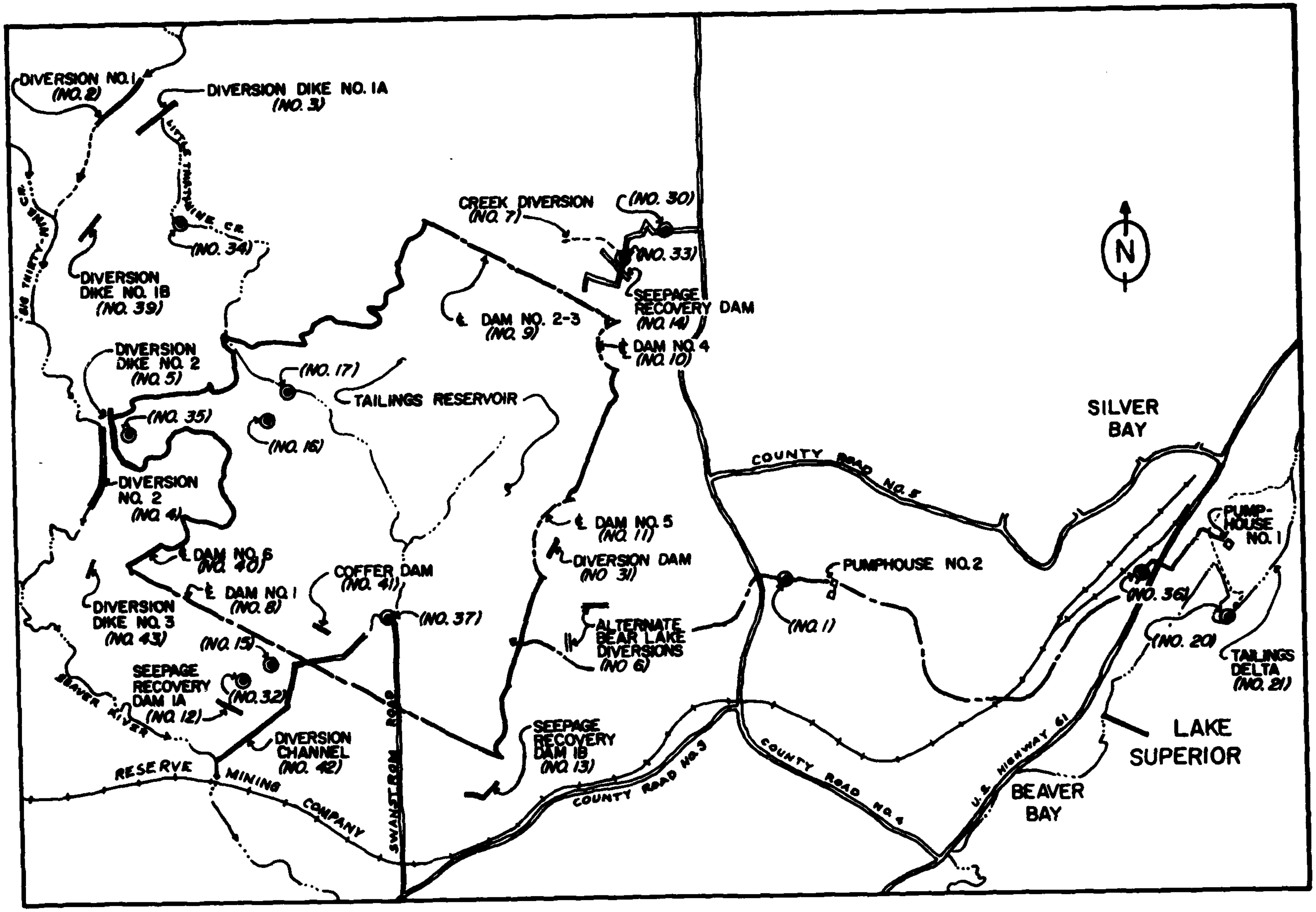

Figure 1

Permit Applications

1.016 In early July 1976 the Minnesota DNR and the MPCA denied Reserve's applications for permits for use of the Mile Post 7 site. Reserve appealed these decisions to the State District Court for Lake, Cook, and St. Louis Counties. On 28 January 1977 the State District Court ruled in favor of Reserve and ordered the State agencies to grant the necessary permits to Reserve for the Mile Post 7 site. The DNR and MPCA are currently appealing this decision before the Minnesota State Supreme Court.

1.017 Following the denial of the permit applications by the State agencies, the U.S. District Court for Minnesota ordered Reserve to halt their air and water discharges by midnight 7 July 1977. Reserve appealed this decision before the Eighth U.S. Circuit Court of Appeals. On 28 October 1976 the Circuit Court of Appeals upheld the District Court decision, ruling that the deadline could be extended if a change in circumstances occurred between the State and Reserve.

1.018 Late in the State hearings, Reserve developed a new design proposal for disposal of tailings to substantially reduce an anticipated fugitive dust problem. On 10 December 1976 Reserve submitted revised permit applications to the Corps of Engineers, predicated on the new design proposal.

1.019 Reserve now has 32 permit applications pending with the St. Paul District, Corps of Engineers (see figure 1). These can be broken down by type as follows:

- 5 Main Dams
- 5 Diversion Channels
- 5 Diversion Dikes
- 3 Seepage Collection Dams
- 6 Road Crossings of Streams
- 3 Rail Crossings of Streams
- 1 Combination Road and Pipeline Crossing
- 1 Coffer Dam
- 1 Tailing Disposal Area
- 1 Delta Stabilization
- 1 Power Plant Discharge Pipe

The above features, save for the delta stabilization dike, are necessary for Reserve to dispose of taconite tailings at the Mile Post 7 site.

PROJECT LOCATION

1.020 The proposed projects are located at Silver Bay, Lake County, Minnesota, about 53 miles northeast of Duluth along the north shore of Lake Superior (exhibit 1). The proposed discharge structure and delta stabilization projects are located on the shore of Lake Superior at the Reserve complex in Silver Bay. The proposed Mile Post 7 tailings disposal site is located about 5 miles inland from Silver Bay.

EXISTING OPERATIONS

1.021 Reserve is involved in the mining, processing, and shipping of taconite ore. Taconite is a hard, gray rock in which are embedded fine particles of magnetite, a black magnetic oxide of iron. It is found in the geological formation known as the Biwabik Iron Formation in northeastern Minnesota. Reserve Mining Company is one of several companies which mine taconite ore from the Biwabik formation and, through a process technically known as "beneficiation," separate the taconite into an iron-rich concentrate which is made into iron pellets and a nearly barren waste product called "tailings." These pellets provide a uniform blast furnace feed for Armco and Republic Steel Companies, parent companies of Reserve, and the market for Reserve's pellets.

1.022 Reserve differs from most other Minnesota taconite mining companies, in that the mining and processing phases of its operations are geographically separated. The beneficiation process occurs at Silver Bay. The taconite ore is actually mined at the Peter Mitchell Mine near Babbitt, Minnesota, located about 47 rail miles to the northwest of Silver Bay, and then rail hauled by Reserve's private railroad to Silver Bay. While all other taconite mining companies in Minnesota transport only the finished pellets to shipping points on Lake Superior, with tailings disposal occurring on-land, Reserve transports the taconite ore itself and disposes of its tailings via discharge into Lake Superior. (Exhibit 2 contains a listing of permits received by Reserve in the past for their discharge.) It is this latter aspect of Reserve's current operations that the courts have decreed must cease.

1.023 Reserve estimates that the crude ore reserves at the Peter Mitchell Mine as of 1 January 1976 were 1,270,449,089 long tons. These reserves could last from 40 to 60 years depending upon annual rate of exploitation and technological advances in the mining industry. Reserve has indicated they would curtail their operations after 40 years if allowed to use the Mile Post 7 site.

1.024 Taconite mining and processing involve basically four sequential steps:

1. Mining
2. Crushing
3. Concentrating
4. Pelletizing

1.025 After the ore deposit has been cleared, the glacial overburden stripped off, and the waste rock overburden and lean ore removed and stockpiled, the taconite ore is drilled, blasted, loaded and hauled from the pit. Each year, Reserve Mines approximately 30.1 million long tons of ore. In order to get to this quantity of ore annually, about 11.8 million long tons (estimated) of waste rock and lean ore (exclusive of glacial overburden) must be removed and stockpiled.

1.026 Blast holes are prepared by rotary drilling in waste rock and jet piercing in the taconite ore. After the holes are drilled, they are loaded with explosives and blasted. Broken waste rock and lean ore are loaded into large end-dump trucks by large shovels. Broken ore is loaded into 90-ton side-dump tractor trailers by 12-cubic-yard electric shovels. The waste rock and lean ore are transported to stockpiles located either in the pit or near the pit. Ore is then transported up to 3 miles to either of two primary crushing plants where the crusher operator dumps the ore into large bins feeding 60-inch gyratory crushers (first stage) that reduce the mine run ore to approximatley 8 inches.

1.027 Following this first stage of crushing are four 30-inch crushers at each crushing plant (second stage), that crush to a rail haul ore product that is less than 4 inches in size. Ore is fed from these crushers onto a conveyor belt and discharged into loadout bins. An 85-ton railroad car is gravity loaded from the bins in 1 to 2 minutes. Cars are then assembled into approximately 150-car unit trains that carry the crushed taconite on Reserve's private railroad southeast about 47 rail miles to Silver Bay.

1.028 The primary crushing plants are included in the mining operation because these plants are part of the Babbit facilities near the mine. The final crushing is included in the fine crushing segment which occurs at the processing facilities in Siver Bay. When the ore trains arrive in Silver Bay, the cars are dumped by two rotary car dumpers in tandem, and the ore is conveyed to storage bins. The 4-inch and finer ore is withdrawn from these bins as required and transferred by conveyor to ten crushing sections in the fine crushing plant (third stage). Ore is crushed from 4 inches to 1-¼ inch taconite during the third stage of crushing, and subsequently to less than 3/4-inch size during the fourth stage. Prior to third and fourth stage crushing, the finer ore fraction is removed by screening and bypasses the third and/or fourth stages of crushing. The final 3/4-inch or finer ore in then conveyed to the concentrator storage bins in the concentrator.

1.029 The 3/4-inch and finer taconite is drawn from the concentrator storage bins at a controlled rate and is conveyed to 22 paralled concentrating circuits. Each of the 22 circuits is basically identical. Crushed taconite ore and water are introduced to the system, and waste tailings and concentrate, both containing water, are the output of the system. The concentrating process is one of repeated grinding, magnetic separation, hydraulic separation, sizing, rejection of non-magnetic waste material as tailings and removal of water (or dewatering). At each succeeding stage of separation, a higher grade of magnetic concentrate is produced.

1.030 Twenty-two parallel cencentrating circuits and recycling are used in concentrating. Tailings are discharged at five points during the process. During this process, the taconite ore is subjected to three stages of grinding, three stages of magnetic separation, three stages of sizing, and three stages of dewatering and hydraulic separation. The plant can also be operated without the regrind circuit. In this case, coarse material from the magnetic separators is sent directly to the hydroseparators. The tailings are collected from each step of separation and then transported down a series of troughs or launders toward Lake Superior. The tailings from the two main launders are discharged onto the tailings delta which has formed out into Lake Superior. A portion of these tailings remains on the delta and the remainder flows into Lake Superior.

1.031 After the iron concentrate leaves the concentrator on a conveyor, it is stored in bins and is withdrawn as needed. At the pelletizing plant, the concentrate is mixed with bentonite (approximately 1.1 percent added). The bentonite adds strength to the pellets before firing, aids in the retention and control of moisture during the forming and handling of pellets prior to firing, and controls the release of moisture during firing. The mixture is conveyed to balling drums where small balls are formed in horizontal, rotating drums. As the pellets are discharged from the drums, they are roll-screened, removing pellets (less than 5/16 of an inch) to be returned to the drum feed, while finished pellets (larger than 5/16 of an inch) are sent by conveyor for firing. The pellets are spread onto horizontal-grate pelletizing machines in which the product is advanced through stages including up and down draft drying, up and down draft heating, burning and two stages of cooling. During this process of induration (hardening), the temperature reaches as high as 2400° F. A chemical change occurs in which the magnetic oxide of iron (magnetite--Fe_3O_4) is converted to the hematite (Fe_2O_3) form. The fuel currently used for pelletizing is natural gas. The hardened pellets, after leaving the traveling grate, are passed over a shaking screen, quenched and conveyed to storage bins ready for shipment, or are stockpiled.

1.032 From the pelletizer, the pellets are conveyed to the loading and storage areas adjacent to the harbor. The harbor at Silver Bay is formed by breakwaters which reach from the shore to Beaver Island and Pellet Island. Ore boats from the lower Great Lakes ports enter the harbor and are loaded at the dock by boat loaders. Through a system of belt conveyors, pellets from the plant can be stockpiled and simultaneously loaded onto ships. Reserve ships pellets 9 to 10 months each year.

1.033 Over the period of years since Reserve began discharging into Lake Superior, a large tailings delta has formed at Silver Bay. The delta is approximately 225 acres in size. A deep (600-foot) trough in the bed of Lake Superior runs parallel to the north shore. The original theory was that all the tailings would flow via a density current into this trough where they would have no effect upon Lake Superior. This theory has held true for only a portion of the tailings.

A delta has been formed and it has been discovered that some of the finest particles (fibers — see glossary) do not settle out but remain suspended in Lake Superior for an indeterminable length of time.

1.034 Reserve operates the Lakeside Power Plant at Silver Bay to provide the power necessary for the taconite operation. Presently there are two generating units at the Lakeside Plant. Unit #1, put in operation in 1955, has a capacity of 50 megawatts (MW); and Unit #2, put in operation in 1963, has an 87-MW capacity.

1.035 The Lakeside Power Plant currently uses 106,293 gpm (gallons per minute) of Lake Superior water for various purposes. Table 1 lists the specific uses of the water. An additional 10 gpm is taken from the Silver Bay municipal water system for non-contact cooling of a monitor probe. Under the present system, the power plant water is discharged into the taconite processing plant and eventually into Lake Superior with the tailings.

TABLE 1

LAKESIDE POWER PLANT WATER USES

USE	AMOUNT (gpm)
Units 1 & 2 Condenser Cooling--Non-contact	105,000
Hydrogen & Oil Coolers--Non-contact	961
Boiler Seal & Water Jacket Cooling--Non-contact	58
Makeup Units 1 & 2 and Process Boilers--Contact	269
Regeneration of Ion Exchange Beds--Contact	5

1.036 In the past, the Lakeside plant used both natural gas and coal for fuel. Since September 1976, Reserve has burned 100 percent coal, as natural gas supplies are no longer available. Reserve estimates it will take 400,000 tons of coal annually to operate the plant at capacity.

1.037 Coal is presently brought into Silver Bay by ship and unloaded directly onto the coal pile adjacent to the power plant. Reserve does not use a dust suppressant as such, other than sprayed water, during the unloading of coal from the ships onto the coal pile. The coal pile is regularly compacted by earth-moving equipment to prevent spontaneous combustion and to avoid blowing coal dust. This procedure, combined with the relatively coarse nature of the coal, has in the past resulted in no noticeable dust problem.

PROPOSED ACTION

1.038 As part of the plan to cease discharge of tailings to Lake Superior resulting from the processing of taconite at Silver Bay, Reserve proposes to: (a) make major changes in plant operations to improve the physical and chemical quality of pellets by increasing the iron content and reducing the silica content and; (b) to dispose of the waste product, tailings, in a tailings basin on land. To carry out these purposes, Reserve has proposed: major changes in

its existing concentrating plant and its concentrate dewatering (filtering) system, a tailings dewatering system, a tailings transport system, on-land tailings disposal, and delta stabilization. The major proposed processing plant changes include: dry cobbing, flotation, screening, concentrate filtering, tailings filtering, and changes in use of power plant cooling water. The proposed tailings transport system involves rail transport of cobbed and filtered tailings, and pipeline transport of fine tailings and return water to the plant. The proposed on-land tailings disposal plan includes tailings dams, tailings pipeline, tailings basin, seepage collection, stream diversions, railraod spur, and access road construction.

TACONITE PROCESSING

1.039 Dry Cobbing Process. A new building is proposed to be constructed between the existing fine crusher and the concentrator on the east side of U.S. 61 to house the dry cobbing equipment (exhibit 3). Dry-magnetic separators are to be used to treat the taconite ore coming from the fine crusher, 97 percent of which is less than 3/4-inch size. This dry magnetic separation process is to reject 22 percent of the taconite ore as coarse cobbed tailings, or 6,598,000 dry long tons per year. With this proposed reduced feed rate, subsequent grinding phases of the process would produce finer-sized products with better liberation of the magnetite, resulting in finer-sized wet tailings.

1.040 Concentrating and Concentrate Filter Processes. The partially concentrated ore from the proposed dry-cobber building would be stored in the concentrator storage bins as in the present process, and then drawn out at a controlled rate and conveyed into the 22 parallel concentrating circuits. However, each of these circuits is proposed to be modified as follows:

a. Fine screening is to replace one stage of cyclone separation.

b. Three new sets of magnetic separators would be added.

c. Primary and secondary flotation is to be added to selectively remove quartz (silica) and amphibole (silicate) particles. A chemical reagent (Arosur F MG-98A) would be required, and a reagent-handling system and building would be constructed. Flotation agents used would be those that prove harmless by bioassay tests under conditions of actual use.

1.041 Concentrates from each of the 22 concentrating circuits are to be pumped to two new hydroseparators and then to a proposed new concentrate filter building where the concentrates would be dewatered by vacuum filtering and conveyed to the pelletizer.

1.042 Tailings Transport. Cobbed and filtered tailings would be conveyed across U.S. Highway 61 to loading facilities, then rail hauled to the proposed Mile Post 7 disposal area. For the Mile Post 7 plan, Reserve proposes to construct 8,500 feet of railroad track in the Silver Bay yard and 5.5 miles of double track spur from the existing Reserve railroad at Mile Post 6.5. Two 25-car trains, each requiring three 2,000-horsepower locomotives, are proposed to be used in the transport of coarse tailings.

1.043 Fine tailings would be sent to clarifiers and dewatered to a slurry containing 60 percent soilds by weight. Settling would be aided by a flocculent (Polymer M-502). The overflow water would be recycled to the concentrator. A double pipeline, 33,500 feet long with an outside diameter (OD) of 24 inches, and rising 625 feet, would be used to pump the slurry to the proposed tailings basin (exhibit 4). One pipeline would serve as a spare. Two pumphouses would be required outside the basin. Pumphouse No. 2 would have dump valves and holding basins for tailings. A service road would be constructed along the pipeline.

1.044 Catchment basins with sufficient capacity to contain the entire contents of the pipeline would be constructed along the pipeline. The pipeline would be self-purging, in the event of a pipeline failure.

1.045 Water Recycling. Reserve proposes to operate with a closed-cycle water system. The system involves water recycling within the concentrating, filtering, and concentrate-filtration systems. Also, excess water would be returned from the Mile Post 7 tailings basin via a 24-inch OD water reclaim pipeline running adjacent to the slurry pipeline. Exhibit 5 shows the estimated water balance of the process.

TAILINGS DISPOSAL

1.046 The tailings would be disposed of at the proposed Mile Pos 7 site about 5 miles inland from Silver Bay. The topography of the proposed tailings basin area is such that a natural valley would contain the tailings with five dams. The dams would be required to close the valley and bridge the gaps in the ridges forming the valley (exhibit 4).

1.047 The basin would be designed to store 40 years' production of tailings, which is the projected life of the operation. The total quantities involved are:

Dry cobbs	-	263,907,360 long tons
Filtered tailings	-	81,668,400 long tons
Fine tailings (39 yrs)	-	477,760,140 long tons
Total:		823,335,900 long tons

Approximately 125,000,000 long tons would be used in dams and splitter dikes leaving 698,335,900 long tons to be stored. In addition to the solid materials, the basin would store approximately 287,277,000 cubic yards of water as void water. Flood storage would be provided above the settled tailings level.

Structures

1.048 The project structures as shown in exhibit 4 include:

a. Five tailings dams, with heights and lengths as follows:

Dam 1, 13,540 ft long and 190 ft high, as shown in exhibits 6-8.
Dam 2-3, 6,570 ft long and 153 ft high, as shown in exhibits 9-11.
Dam 4, 2,180 ft long and 125 ft high, as shown in exhibits 12-14.
Dam 5, 3,360 ft long and 158 ft high, as shown in exhibits 15-17.
Dam 6, 1,650 ft long and 14 ft high, as shown in exhibits 18-19.

b. Seepage recovery dams and related structures as shown in exhibits 20-24.

c. Headwaters diversion Nos. 1 and 2 on Big Thirty-Nine and Little Thirty-Nine Creeks as shown in exhibits 25-29.

d. Diversion works on Bear Lake as shown in exhibit 15.

e. Splitter dikes within the tailings pond as shown in exhibit 30.

1.049 The tailings basin is to be operated as a closed circuit and, consequently, any excess water would have to be stored in the basin with the tailings. To reduce dust problems, it is proposed that a deliberate excess of water be accumulated initially so that the deposited tailings would always be covered by water.

1.050 The fine tailings and excess coarse tailings would be deposited in the basin at suitable points, along the dams and splitter dikes within the basin. The splitter dikes would support the railway tracks (exhibit 31) for delivery of the coarse tailings to the tailings basin area and would also support the pipelines for the fine tailings. They are necessary to insure adequate distribution of the materials over the large basin area. To provide sufficient storage capacity for 40 years of operation, the five dams would be constructed with crests at an elevation of 1315 feet.

1.051 The natural runoff entering the tailings pond would be minimized by the construction of the headwaters diversion works noted above. The excess runoff and transport water ponded over the settled fine tailings would be reclaimed for re-use in the milling operations. Seepage through or under the dams would be collected by the seepage recovery facilities and returned to the pond. No water problems are anticipated in operating the pond as a closed-circuit operation.

1.052 The dams would be constructed over a period of years in such fashion and at such rate that there would always be ample freeboard above the rising pond to insure against accidental overtopping in the event of an exceptional flood. To prepare the basin initially, low starter dams would be constructed at all but Site 6, using natural soils obtained locally. Subsequent dam construction would then utilize mainly coarse tailings, placed concurrently with the deposition of fine tailings into the pond.

1.053 The locations, configurations and compositions of the proposed main tailings and seepage recovery dams have been influenced by a number of factors, the more important of which are:

1. Topography
2. Environmental requirements
3. Foundation materials
4. Available construction materials
5. Seepage considerations
6. Need for further site information, during and after construction.
7. Control of water during construction.

1.054 Dam No. 1 has been sited as far downstream as is reasonably possible without requiring excessive volumes of fill. Dam 2-3 has been sited so as to help reduce the catchment area of the pond and is, in fact, a substitute for an earlier arrangement that involved two dams, one paralleling Dam 2-3 about a half mile further to the northeast and the other at right angles to that, across the small stream that passes the toe of Dam 2-3. Dams 4, 5 and 6 are saddle dams to close low points on the tailings pond rim. Minor adjustments to dam alignments may be made to optimize locations when detailed topographic surveys are completed.

1.055 The ultimate crest of the tailings dams has been set at el. 1315, which is sufficient to store: all of the fine tailings, all of the coarse tailings not used in dam construction, and all of the surplus water that is expected to accumulate from the milling process and to flow from the net catchment area, assuming a 40-year operating life for the project. This level does not include allowance for settlement, which would be monitored during the project life to determine additional allowances required before shut-down to allow for very long-term settlements. Seepage recovery dam heights are governed by hydraulic requirements.

1.056 Railway Construction and Operation. Railway lines would be constructed by Reserve Mining Company to connect the existing Silver Bay-Babbitt railway with the dams and the tailings basin. Initially, the railways are required to supply construction materials for starter dam No. 1. Later, when tailings are being produced in the plant, the railways are also required to transport the coarse tailings. Coarse tailings hauled by rail would be used for dam and splitter dike construction as well as being dumped into the basin.

1.057 An initial construction railway would be built as shown in exhibit 31. As the tailings pond rises, the dams and splitter dikes would be raised also and the railway location would be moved in stages to cross dam 1 at increasingly higher elevations.

1.058 The initial construction railway to the dams would be on a cut and fill grade, constructed from locally borrowed material. Splitter dikes are to be constructed of coarse tailings. Railways inside the basin area would be raised above the initial grades with coarse tailings. The north-south railway line through the center of the reservoir would act as a splitter dike and would likely be used as a dike from which to deposit fine tailings.

1.059 Railways subsequent to the inital line would cross Thirty-Nine Creek on seepage recovery dam 1A. Detailed design of the dam crossing and the crossing of the emergency spillway at the dam would be done when railway alignment and grades and the spillway dimensions are finalized.

1.060 Four months of construction time has been estimated to build the railway from the existing line to starter dam No. 1. Sand and gravel from the Mile Post 32 pit would be supplied by three trains per day with an estimated average load of 650 cubic yards per train. For scheduling purposes it has been assumed that dam construction would run from April 1 to November 30 each year with gravel hauled and stockpiled in the remaining 4 months.

1.061 Construction Materials. The coarse fractions of the tailings, i.e., filtered tailings and dry cobbs either individually or mixed, are excellent materials for dam construction. Therefore, the maximum use of coarse tailings for dam construction has been a primary objective in the design.

1.062 Other materials are also required, for early construction before coarse tailings are available, for impervious membranes, for special filters, and for wave protection. These would be supplied from borrow pits in the pond area, from along the Company railway line, and possibly from the mine pit.

1.063 Glacial till from local pits in the pond area (exhibit 32) would be used for the seepage recovery dams, Starter Dams 2-3, 4, and 5 for Tailings Dam No. 6, and for impervious membranes on all of the tailings dams and on Starter Dam No. 1. Sands and gravels from a pit at Mile Post 32 would be used for Starter Dam No. 1 construction and for special filters and drains. Rock from the mine pit or alternative sources would be used for riprap on the dams.

1.064 The glacial till borrow areas are close to the dams. However, the till is a difficult material to place, requiring dry summer weather to avoid excess moisture conditions. For Starter Dam No. 1, the use of galcial till as the main material was found to be undesirable due to the large volumes required, the uncertainties of

weather, and the limited time available. For Starter Dam No. 1 it is therefore planned to use mainly sand and gravel borrowed from Mile Post 32 on the Reserve railway. Only the sloping impervious membrane would be built of glacial till. For Seepage Recovery Dams, 1A, 1B and 2-3, and for Starter Dams 2-3, 4 and 5, the volumes are much less and the construction schedule is such that glacial till materials can be used for those initial structures. Glacial till would also be the main material for Tailings Dam No. 6.

1.065 Construction Materials Handling. Sand and gravel would be hauled to the damsites by trains of side-dumping ore cars. Loading at the pit at MP32 and stockpiling, moving, spreading, and compacting in the embankments would be by conventional earthmoving equipment.

1.066 Coarse tailings would be supplied to the tailings area by train. After they were side-dumped from the railway cars, the coarse tailings would be spread by bulldozers or large graders. The railway tracks would periodically be relocated on the fill to minimize the distance that the tailings have to be pushed.

1.067 Glacial till would be handled by conventional earthmoving equipment from the borrow through hauling to spreading and compacting. Either scrapers and bulldozers or loaders and trucks could be used for this operation. Borrow pit planning over the life of the construction is required to insure an adequate supply of suitable material as the tailings pond rises and inundates the borrow pits.

1.068 Construction of roads and railway grades (except those within the pond area) would be with local materials, with maximum use being made of cut and fill techniques.

1.069 Construction Schedule. A tentive construction schedule is presented in exhibit 33. This schedule is intended as a guide to constructing the tailings disposal facility and not as a program to be rigidly adhered to. Several fundamental assumptions have been made as listed below:

- Time zero of May 1 (approval for construction)
- Four months mobilization time required for heavy equipment
- Start of coarse tailings production, month 24 after go-ahead given
- Start of fine tailings production, month 36 after go-ahead given
- Coarse tailings construction in dams for 8 months per year only
- Glacial till placement in dams for 2½ months per year only

Using all the available coarse tailings for dam construction, it would take approximately 18 years from the go-ahead date to complete the tailings dams. This time represents the shortest possible construction time for the dams.

1.070 The longest possible construction time is approximately 40 years with construction just ahead of the rising pond. Actual construction time would depend on many factors, some of which are listed below:

- economics of construction
- actual rainfall throughout the life of the project
- actual water reclaim rates
- performance of dam foundations as monitored by instruments (A limit on the maximum rates of construction could be set if foundations do not consolidate as rapidly as assumed.)

Construction in the early part of the schedule would be significantly affected by the time of year that the go-ahead is given, as many construction activities are seasonal.

1.071 Future Design Considerations. Some areas of the present design have not been finalized because more detailed information is required to complete the designs. It is intended that these designs would be completed once the construction work commenced.

1.072 Apart from design in specific areas there would be steady monitoring of performance of dams and foundations using installed instrumentation, checking of the readings, and comparing of the adequacy of the designs against the actual performance of structures.

1.073 Specific areas where designs would not be finalized until construction is started are as follows:

- Damsites 4 and 5
- Seepage Recovery Dam No. 2-3 diversion route
- Emergency spillways at seepage recovery damsites
- Ultimate spillway for pond
- Routing requirements for east abutments of dams 1 and 2-3
- Bear Lake final diversion

1.074 Diversions Nos. 1 and 2. Headwaters diversions Nos. 1 and 2, as shown in exhibits 25-29, would reduce the catchment area of the tailings pond by a total of 22.6 square miles. That total is made up of 5.5 square miles on Little Thirty-Nine Creek and 17.1 square miles on Big Thirty-Nine Creek. Diversion No. 1 discharges into Big Thirty-Nine Creek above Diversion No. 2. Consequently, the latter channel would carry the combined flows from the two catchments.

1.075 Both diversions have been sized to pass the estimated probable maximum flood peaks, 17,000 cfs for Diversion No. 1 and 40,000 cfs for Division No. 2. The probable maximum flood was selected for design of these diversions so as to reduce to an absolute minimum the risk of diversion-dike failure which might release water into the tailings pond that would be additonal to the water for which the pond has been designed.

1.076 The dike crest elevations shown are set to provide a freeboard of 3 feet above the calculated design flood profile. Dikes No. 1A, No. 1B and No. 3 are set back sufficiently far so that they should not be exposed to erosion by the flood flows in the main channel. Dike No. 2 would be exposed to flows that could briefly reach 7 or 8 feet per second. Heavy riprap would be provided on the exposed portions of this dike.

1.077 The large excavated area in the channel at Diversion No. 2 is based on balancing of channel costs aganist dike costs. Without the excavated channel, the dike would have to be further east where it would be considerably larger. Dike No. 3 is required to close a low gap alongside the diversion route.

1.078 The diversion dikes would be constructed mainly of locally borrowed glacial till and would be placed in thin, well-compacted lifts. With the exception of those portions in the immediate area of the original creek channels, the dikes would be exposed to water loadings for only brief periods. Consequently, through-seepage would not be a concern over most of the lengths and toe-drainage provisions in the dikes are required only across the old stream channels.

1.079 Eventually Diversion Dike No. 2 would be required to serve as a tailings retention dike and would be exposed to the tailings pond over most of its length. Consequently, it would be provided with very carefully designed drainage features under its western slope to provide for the long-term seepage possible between the tailings pond and Diversion Channel No. 2. Seepage through this dike is not expected to exceed 8 USGPM.

1.080 Dam No. 1 Diversion. This diversion, shown in exhibit 22, is required to control flows through Dam Site No. 1 during construction of Starter Dam No. 1 and Seepage Recovery Dam No. 1A. Because Diversions Nos. 1 and 2 would have been constructed previously, this diversion would have a catchment area of only 8.7 square miles. This diversion would be needed for a period of two years and since no significant volume of water would be impunded, a design flood of 20 years has been adopted. The peak design flow is 900 cfs.

1.081 The diversion comprises a low cofferdam across Thirty-Nine Creek upstream of Starter Dam No. 1 and an open cut channel through the left abutment to a point downstream of Seepage Recovery Dam 1A. This would leave the entire work area for the two dams clear of the rerouted stream channel and would allow operation of the Seepage Recovery Dam pond as a settling pond for controlling turbidity during construction of the starter dam.

1.082 When the starter dam is completed to the west of the diversion channel, and the start of tailings deposition is anticipated, the entrance to the channel would be blocked during a period of low flow. Water approaching the dam would be pumped past the area with construction dewatering pumps. The pumping would be continued until a plug had been built in the channel, as part of the upstream slope of the starter dam, to a least El. 1150.

1.083 Seepage Recovery Dam No. 2-3 Diversion. This diversion would be required to remove from the seepage dam catchment, a small stream that flows in from the west. Catchment area for the diversion would be 450 acres. Because the feature being protected would be the seepage recovery dam, the design flood should be comparable to that used for design of the protected works - in this case, a 10,000 year recurrence interval. The design flood for this diversion is 750 cfs peak flow.

1.084 The channel in which the stream is presently flowing and across which Seepage Recovery Dam 2-3 must be built is very steep and, because it is in overburden throughout the length involved, it is no doubt subject to fresh erosion, at least during exceptional floods. Any diversion channel around the dam site must cope with the large elevation changes and, at the same time, should be protected against damage by erosion. The alignment of the channel shown in exhibit 24 is aimed at satisfying this requirement by placing the steeply sloping downstream section at a point where bedrock is expected to be at shallow depth. The upstream section, in the overburden, would have a gradient consistent with non-erosive velocities for glacial till. The downstream end would be aujusted to insure that the high velocity flow is on rock. The exact final alignment of this channel would depend on the results of further investigation to define the bedrock surface at the downstream end.

1.085 The channel invert width has been set by construction requirements and side slopes are set to minimize slumping and consequent contamination of the flows. Depth of flow during passage of the design flood would be about 5 feet and maximum velocity would be about 5 feet per second.

1.086 As with Diversion Nos. 1 and 2, exceptional flood flows could deposit debris in the upstream end of the diversion channel, so periodic maintenance to remove such debris would be required. The dike in this area would be increased in height to compensate for possible channel filling during individual floods. Channel filling would not be a long-term problem because the seepage recovery dam which it protects would not be a permanent structure and would eventually be breached when no longer required.

1.087 Bear Lake Diversions. The outflow from Bear Lake runs into the tailings basin through the Dam No. 5 site and, while the volume of runoff is small relative to that from the entire tailings pond catchment, it is nevertheless sufficient to cause problems during early construction at Dam No. 5 and must be diverted. Once Dam No. 5 reaches about El. 1200, it would be necessary to divert these flows out of the tailings pond catchment altogether. This would occur some time in about the eighth year after start of construction.

1.088 The initial, temporary Bear Lake diversion would be necessary to direct the lake outflow around the Dam No. 5 starter dam and the early embankment lifts. Because it would be required to serve for only about 8 years and because a failure would do a minimum of damage, a 100-year return period design flood has been adopted for this diversion. The design flood peak flow routed through the lake is 50 cfs.

1.089 The diversion would consist of a simple channel excavated parallel to the contours past the south end of Dam No. 1, as shown in exhibit 15. As the anticipated flow is small, the channel dimensions are dictated by construction and side slope stability requirements. The invert gradient is set to pass the design flood at non-erosive velocities for the glacial till soils expected along the route. At the downstream end it is expected that the channel would be in rock cut, and that the flows could be released freely beyond that point to flow downslope into the tailings pond. Any erosion on the steep slope below the rock cut would not progress backward into the main channel because of the protection afforded by the rock cut. However, the presence of rock in this area has not been definitely confirmed at this time and, should it not be found within reasonable depth for inclusion in the channel, an alternative non-erodible means would be developed for releasing flows from the upper channel. That could take the form of a flume, a pipe conduit, or even a riprap-lined channel down the slope.

1.090 When the rising tailings pond and the Dam No. 5 construction reach a level that would interfere with the temporary diversion channel described above (about El. 1200), it would be necessary to divert the lake outflows in the opposite direction, away from the pond. At that time the present lake outlet would be permanently closed by a low dam, and an outlet channel would be excavated at a point on the lake perimeter yet to be decided. Because the entire flow is to be diverted, the closure dam at the present lake outlet would have no water passages or spillway and would have sufficient height to direct the probable maximum flood through the new outlet. The diversion dam would serve also as a positive separation between Bear Lake and the seepage recovery pond at the back of Dam No. 5.

1.091 There are two points along the Bear Lake rim where new outlets are physically possible, one at the south end and the other about midway along the east side. At both locations the present ground level is about 20 feet above the lake which leaves two or more alternatives regarding the final lake level. An outlet channel excavated to present lake level would involve quite large excavation volumes. On the other hand, to raise the lake as required to flow out over the saddle would entail a much larger diversion dam and would permanently flood out the present lake shore to about 20 feet depth.

1.092 Decisions on the future lake level and the outlet channel locations have been deferred for the present, pending clarification on property matters. However, the problem has been assessed and there is no question that the proposed diversion is feasible.

1.093 As the final diversion would be permanent, the design flood adopted should be based on a probable maximum storm, which is estimated to produce a peak inflow of about 2,000 cfs and a volume of about 400 acre-feet. The actual outflow should, however, be considerably less that the 2,000 cfs peak shown because of the routing effect provided by the lake. The narrower the channel, the smaller the outflow rate, but the greater the rise and fall of the lake during a storm, and vice-versa. The decision on the size of the diversion channel would also be made later, when it is possible to determine more accurately the relative merits and disadvantages of high discharges versus large lake level changes.

1.094 Tentative hydraulic calculations indicate that a minimum practical width of channel of about 12 feet at the invert would limit the peak outflow to about 600 cfs during a probable maximum flood, and would cause fluctuations in lake level of about 7 feet. This range of water levels appears reasonable, but could be decreased by widening the channel, at the expense of increased flow downstream.

1.095 Seepage Recovery Facilities. Seepage water passing through the tailings dams and rainfall percolating through the downstream dam embankments would not be permitted to enter the downstream drainage system until such time that tests show the water to meet acceptable water quality standards. Small, watertight ponds would be developed near the downstream toes of the tailings dams to collect any seepage from the tailings pond and the runoff from the small watersheds between the tailings dams and the seepage recovery ponds. This combined seepage and runoff would be pumped back to the tailings pond. Design of the dams is shown in exhibits 20, 21, and 23.

1.096 No seepage recovery facilities have been designed for Dam No. 6 and Diversion Dike No. 2, as these are mainly freeboard structures and seepage would be very small. There would be no coarse tailings in these structures so percolating rainfall is not a concern.

1.097 The estimated dam and foundation seepage rates are summarized below:

	Maximum Seepage, USGPM
Dam No. 1	385
Dam No. 2-3	142
Dam No. 4	not calculated*
Dam No. 5	not calculated*
Dam No. 6	3
Diversion Dike No. 2	8

The above predicted seepage rates are very small compared with storm runoff from the seepage recovery pond catchments. The quantities of water to be stored in the seepage recovery ponds are minor relative to the volumes that would be flowing in the stream channels downstream during a storm of sufficient magnitude to overtax the seepage recovery facilities. To be absolutely safe, the design has been based on a 10,000-year recurrence interval.

1.098 It is impractical to provide seepage recovery pumping capacity equal to the peak rate of rainfall runoff. In fact, it is necessary to allow several weeks for recovery from a severe storm, and hence the runoff periods to be studied should extend over similar intervals. Accordingly, the hydrologic studies were designed to provide 10,000-year recurrence interval rainfall for periods of from 1 to 60 days. In summary, rainfall values with a 10,000-year recurrence interval for the Silver Bay area are estimated to be as follows:

Period	Total Rainfall for Period
1 day	8.0 inches
30 days	16.0 inches
60 days	24.0 inches

With natural terrain, absorption by vegetation and soil would result in actual runoff quantities significantly lower than the above. However, the particular catchment areas involved would be within the zones of dam construction activities and would initially be completely free of vegetation. There would be extensive ditching to assist drainage and, in addition, the soil in the area is practically impervious. It was considered advisable to assume zero loss due to absorption and evapotranspiration.

1.099 The total volumes of runoff resulting from the above 10,000-year recurrence interval rainfall amounts are as follows:

Seepage Recovery Pond	Catchment Area, Acres	Runoff Volume, Acre Feet 1 day	30 days	60 days
1A	370	247	535	777
1B	114	76	167	243
2-3	203	136	298	435
4	14	9	20	29
5	32	21	43	61

* Seepage rates at Dams 4 and 5 were not calculated as foundation details at these sites are not known. However, it is likely that these rates would not exceed a few tens of USGPM.

1.100 The mimimum storage volumes and minimum pump capacities would be about as follows:

Seepage Pond	Minimum Storage Volume Acre Feet	Minimum Pump Capacity USGPM
1A	400	3,000
1B	104	1,000
2-3	183	1,750
4	9	150
5	93	250

1.101 The crest elevations for the seepage recovery dams have been set to provide the above volumes of storage, with appropriate allowances for dead storage and silting, and with 3 feet of freeboard for wave run-up. Pumping rates are well in excess of the through-seepage from tne tailings pond, and would evacuate the full amounts of inflow from a 10,000-year storm in a period of 30-60 days, with ample freeboard.

1.102 To assist in evacuating the water in the rare event of a rainfall in excess of the 10,000-year recurrent wet period, each pond would be provided with a spillway channel which, in conjunction with the pumps, should restore water levels to the normal design range in reasonable periods of time. For this purpose, minimal widths of channel would be about 12 feet at the invert, set by construction limitations. Channel gradients would be flat, between 0.001 and 0.002 per foot.

1.103 At Seepage Recovery Dams 1B, 2-3 and 4, rock is expected to be at shallow depth along the spillway lines and the channels would be so aligned as to place the inverts in rock. At Seepage Recovery Dam 1A, the rock is probably at excessive depth and the best that can be done is to route the channel across the right abutment where it would be in glacial till. The chosen location also takes advantage of a natural erosion feature in the form of a small stream entering just downstream of the dam on the right. That stream has established a reasonably stable gradient and bed, probably in the glacial till. By so aligning the spillway channel to have a gentle gradient and to exit into this natural channel with no drop at the outlet, it should be possible to provide for significant releases from the pond with minimal erosion. Full details of this channel cannot be established until the area has been cleared and explored in more detail. Rip-rap in the channel may be necessary as an added precaution.

1.104 No spillway is provided at Dam 5 at this time because it is expected that there would be ample storage volume there for any eventuality, even a probable maximum storm.

1.105 When tests show the runoff water is no longer being contaminated by the coarse tailings, due to leaching action, the pumping facilities would be shut down and the seepage recovery dams breached to permit complete drainage of the recovery ponds at all times. Construction

of the tailings dams could end as early as 20 years before completion of mining and it is expected that the runoff entering the recovery ponds would be of relatively good quality by the time of shut-down.

1.106 Tailings Pond Operation. Fine tailings would be pumped to the tailings pond as a dense slurry. Coarse tailings in surplus of construction requirements would be hauled to the pond by rail car.

1.107 When the fine-tailings slurry is discharged into the tailings pond, the mineral fractions would settle out and free water would become available. Natural drainage into the tailings pond would contribute additional free water. Because the tailings pond would be a closed system, a continuous accumulation of free water is impractical. Consequently, free water must be reclaimed to the mill for re-use in the circuit at an average rate that would balance the inflows. Except in the event of unusually high runoff, the reclaim rate would be kept low in the early years of operation so that the deposited fine tailings could be covered by water. The reclaim rate would be accelerated towards the end of the operating life to permit reclamation of the newly-created land, and to leave a minimum of water ponded at the termination of operations. Areas exposed as the pond is reduced would be reclaimed and seeded.

1.108 The fine-tailings slurry transported to the reservoir would be a fluid containing up to 60% solids by weight. Upon discharge of the slurry, the mineral fraction would settle out in a loose, saturated condition. Experience at other tailings damsites and laboratory tests performed on the Reserve tailings indicated that the fine tailings would settle to an average void ratio of about 1.1. Based on a specific gravity for the solids of 3.1, the average dry density of settled tailings would therefore be about 92 pounds per cubic foot (pcf).

1.109 Densities of deposited fine tailings were measured in a large-scale test deposit of fine tailings at the Reserve plantsite during April and May, 1975. The report issued on 10 November 1975 indicated a minimum dry density of deposited fine tailings of approximately 94 pcf and an average dry density of approximately 97 pcf. However, all estimates of volume are based on the more conservative density of 92 pcf developed earlier, on the basis of experience and laboratory tests. Higher actual densities would provide greater margins of safety.

1.110 There would be minor variations in density of the deposited fine tailings from the average; the coarser fraction near the point of discharge would be slightly denser than the finest portion deposited away from the point of discharge. In addition, during the projected 40-year pond filling period, some consolidation of the tailings would occur at depth. The coarse tailings would be deposited in a loose state, for which the average dry density has been estimated to be 129 pcf.

1.111 Slopes of the hydraulically-deposited fine tailings would be quite flat and would also be highly variable. The tailings reservoir is to be operated with a relatively large pond area, so that the fine-tailings slurry discharge would normally be made directly into or close to a body of water. Such deposits are usually characterized by two distinct zones similar to the foreset and bottomset slopes of natural delta deposits. Immediately below the water surface, the slope is relatively steep. This steep slope (or foreset slope) is usually of a finite height that depends, in part, on the strength of the deposited tailings. Beyond the foreset beds, the finer portion of tailings settle out to more random, but relatively flat, slopes over the reservoir bottom.

1.112 The mechanically deposited coarse tailings would assume slopes equal to the normal angle of repose for the material, both above and below water level. Slopes assumed for the reservoir-operation studies are as follows:

Case	Slope
Coarse tailings above and below water	1.2 horizontal to 1 vertical
Fine tailings from water surface to 10 feet depth	5 horizontal to 1 vertical
Fine tailings below 10 feet depth	67 horizontal to 1 vertical

1.113 Following the proposed plant modifications, 12,250,260 long tons of fine tailings would be produced yearly and deposited in the tailings reservoir. Exact rates to transport water required for efficient pumping of the tailings are not yet defined, but current estimates indicate about 4,170 USGPM, which is the average rate used in this report. The total average slurry-pumping rate, with water and tailings, is about 6,130 USGPM.

1.114 When the tailings have settled to a dry unit weight of 92 pcf, approximately 4,245 USGPM of settled fine tailings would result, of which about 2,215 USGPM would be water retained in the voids; the remaining transport water would become free water and would be reclaimed. Approximately 921,000 cubic yards of settled fine tailings would thus be deposited each month and, because the milling process and method of fine-tailings transport are not expected to be altered significantly for the duration of the project, that rate of fine-tailing deposition has been assumed constant for the 40-year period of mine operation.

1.115 The rate of coarse-tailings production from the mill would also be relatively constant but, because of its use in construction, the rate of coarse-tailings deposition in the pond would vary from zero at times up to a maximum of 463,000 cubic yards per month. Water absorbed into the voids of the coarse tailings would also vary, from

zero to a maximum of about 680 USGPM. Exhibit 34 shows the estimated rate of tailings-rise throughout the assumed 40-year project operating period. Exhibit 35 shows the clearing limits for the 40-year life of the project.

1.116 Additional to the free water that becomes available from the transport of fine tailings to the pond would be the rainfall runoff from the natural catchment. With Diversions 1 and 2 in operation, the reservoir catchment area would be reduced to approximately 8.7 square miles. Of that total area, a portion would be covered by the ponded water, and a portion would be cleared. The remaineder of the area would be essentially unchanged from its natural state. Each of these areas would have different runoff characteristics, and the proportions of each area to the total would change as the reservoir fills and as clearing continues.

1.117 The most important requirement of the tailings-pond operating studies was that of insuring adequate levels of freeboard between the rising pond and the dam crests at all times. As spilling or decanting is undesirable in a closed circuit system, this requirement dictates that unusual climatic conditions must not result in overtopping. Therefore, the pond-operating study adopted extremely conservative assumptions regarding emergency storage capabilities for the pond. These assumptions are that there should, at all times, be sufficient freeboard on the pond to absorb runoff at an annual rate equivalent to that expected during a 5-year wet period having a 10,000-year recurrence interval, plus a probable maximum storm of 96 hours' duration, plus a suitable allowance for the wave run-up that would occur during a 1,000-year wind following the probable maximum storm.

1.118 The average annual rainfall is about 28 inches; the average annual rainfall during a 5-year wet period with a 10,000-year return period would be about 44 inches; and the rainfall for a 96-hour probable maximum storm would be about 30 inches. The evaporation and evapotranspiration rates are:

Water Surfaces	25 inches per year
Natural Surfaces	15 inches per year
Cleared Surfaces	5 inches per year

1.119 Assuming that these evaporation and evapotranspiration rates would be reasonably constant from year to year, the following annual rates of runoff were obtained:

Nature of Catchment Areas	Average Year (Inches per year)	5-Year Wet Period (10,000-Year Recurrence Interval) (Inches per year)
Water Surfaces	3	19
Natural Surfaces	13	29
Cleared Surfaces	23	39

Because the runoff from the probable maximum storm would occur very rapidly, no allowance has been made for evaporation or evapotranspiration. There would, of course, be some temporary retention of water by ground-absorption during the storm, but most of this retained water would drain into the pond in due course. Accordingly, it was assumed that the runoff from the probable maximum storm would be equal to the rainfall, i.e., 30 inches.

1.120 Exhibit 36 shows the design water levels and reclaim rates used in the pond operating study. Exhibit 37 shows how the design water levels fit with dam crest levels predicted from the dam construction scheduling. With a relatively constant rate of transport water inflow and a highly variable natural runoff, it follows that the water reclaim rates must also be variable. However, because a very large pond would be needed to keep the bulk of the tailings covered, the actual variations can be reasonably long term, i.e., 1 or more years at any particular rate.

1.121 It has been assumed that there would be no reclaim for the first year after closure of the diversion at Dam No.1, to allow accumulation of sufficient water to keep the deposited tailings covered.

1.122 Study has indicated that a rate of 6,000 USGPM would be required to cope with the 5-year design wet period if it occurred during the critical 5-year period immediately following closure of the diversion. The studies indicated that a 6,000 USGPM pumping rate would also be required during the last few years of operation when the free-water pond is being reduced in volume. Because the mill design would not accommodate much more than 6,000 USGPM, a wet period at the end of operations could result in a delay in drawing down the pond and the reclamation activities.

1.123 It is not reasonable to provide pumping facilities that would quickly evacuate the runoff from a probable maximum storm, because that would greatly exceed the mill requirements and would have to be released into the environment. Therefore, should a probable maximum storm occur during a wet period, such that the design reservoir level is reached, the freeboard on the dams would be increased instead. This can be done with relative ease even in the critical early years of construction, using the downstream portions of the dams as a source of borrow material if the need becomes particularly urgent. At the end of the sixth year of operation, the freeboard would be more than adequate in any event, and excess water from an unusual storm could be reduced gradually over many years and at rates within a range acceptable to the mill.

1.124 Even though quite flat slopes are anticipated for the deposited fine tailings, it is not possible to properly fill the pond from the perimeter only. Consequently, the tailings pond would be divided into a number of cells by splitter dikes, from which dikes the tailings can be deposited out into the pond. The system of splitter dikes shown on exhibit 30 is expected to suffice.

1.125 The dikes would serve not only to support the tailings pipelines but would also serve as railway spurs for transport of coarse tailings. Consequently they would be built of coarse tailings acceptable for railway standards. Culverts would be installed to balance water levels between cells.

1.126 The fine-tailings slurry would be discharged from spigots which are small lines branching from the main pipelines on the dam and splitter-dike crests. To avoid erosion of the dams, the spigots would be long enough to extend down the slopes and to discharge directly into the pond. Floats on the spigot ends would keep them from being buried.

1.127 The rates of slurry discharge at any one point should be kept low in order to get a reasonable period of discharge before the deposit becomes exposed. Consequently, the spigots should be small, about 4-inch diameter maximum, and they should be spaced at not more than about 1,000-foot centers. Care would be taken to avoid spigotting close to the water-reclaim pump barge so as to avoid causing turbid water in that area.

1.128 The coarse tailings would be transported to points along the pond shores and onto the splitter dikes in side-dump railway cars and would be pushed out from the dikes onto the submerged fine-tailings deposits. By careful planning of these operations, it should be possible to limit the areas of exposed coarse tailings to widths of not more than 300 feet at any one time.

1.129 Coarse tailings must not be placed along the faces of the tailings dams because such action would create wide pervious zones down the faces of the dams. These pervious zones would nullify the reinforcing effect that the fine tailings are intended to provide for the thin glacial-till membranes.

1.130 When the project nears the end of the mine life, special efforts would be made to raise the tailings level in some of the cells above the average level of the settled tailings, to heights equal to or slightly below the average level of the ultimate pond area. A coarse-tailings cap several feet deep would then be worked out over the cells to provide a firm and stable final surface. Seeding and reforestation would proceed concurrently.

1.131 Fine tailings produced during this final period would continue to be dumped in cells that would be deliberately left low for that purpose. These cells would also comprise the final lakes or ponds. Coarse-tailings beaches would be placed around the lakes to provide safe footing.

1.132 The free-water pond would be reduced in volume and area concurrently with placing and seeding of the coarse-tailings topping layer. The result would be a large meadow with one or more small ponds, with the entire area protected at the extremities by the

tailings dam standing several feet above the general level. The average level in the ultimate tailings pond area would be about El. 1305 while the dam crests will be El. 1315.

1.133 The 10 feet of freeboard above the average pond level is about double the volume required to store the runoff from a 96-hour maximum probable storm on the 8.7-square-mile catchment. Consequently the ultimate spillway would not be required to handle peak flows, and need only be sufficient to cope with normal flows and to restore water levels in the ponds to normal within a reasonable period of time after unusual floods.

1.134 The final spillway location has as yet to be determined, but it is expected to be at one of several suitable points in the rock area of the east ridge. The site chosen would be such that the outlet end of the spillway channel is in sound rock to protect against erosion. A low concrete weir would serve to provide a positive control level.

1.135 A minimal width of channel (12 to 15 feet) should suffice to cope adequately with any conditions that can be conceived. Average annual flows would be in the order of 10 cfs and the peak flows following an extreme storm should not exceed 500 cfs. Crest level for the concrete weir would be on the order of El. 1303. That level would, of course, also be the minimum level for the small ultimate free-water pond or ponds.

1.136 A somewhat more elaborate spillway control facility may be adopted if it is found necessary to limit the maximum discharge rates. This might take the form of a pipe or port set in the weir so as to throttle the flow more than would be possible with just a free crest and open channel. The need for such measures can only be resolved when the site has been selected and hydraulic studies have been done on downstream channel characteristics.

POWER PLANT MODIFICATION

1.137 Currently, the condenser cooling water, along with all other water used in the Lakeside Power Plant, is discharged into a sump where it is then used in the taconite-processing operation. Under the new proposal, Reserve proposes to use a closed-cycle water system for the taconite-processing operation. Thus, a new discharge point for the condenser cooling water would be necessary. All other water used in the power plant, such as boiler blowdown, floor drains, boiler wash-water, etc., would continue to be routed to the taconite-processing operation for use there. Sanitary wastes would continue to be routed to the Silver Bay municipal sewage system.

1.138 Reserve proposes to close the existing power plant intake structure, and modify the existing intake for the taconite plant to serve the power plant once the taconite operation goes to the closed-cycle water system.

1.139 Reserve proposes to discharge condenser cooling water via a steel pipe of 6-foot diameter, running from the power plant along a presently in-place rock breakwater to, and across, Beaver Island (exhibit 38). Th pipe would carry the heated discharge water to a concrete diffuser constructed on the southwestern corner of the island. From the diffuser, a 6-foot-diameter steel pipe would extend about 180 feet into the lake and rest on a rock-fill berm placed on the lake bottom. A 5-foot by 4-foot outlet nozzle would extend about 10 feet beyond the rock fill. The nozzle center would be a minimum of 20 feet from both the lake surface and the bottom.

1.140 The berm would be constructed of mine waste rock (rock from the mine too low in ore content to be usable in the taconite processing). About 2,000 cubic yards of tailings and sediments would be dredged from the site to provide a stable base for the berm. This material would be disposed of on the tailings delta. About 2,000 cubic yards of mine waste rock would be needed to construct the berm. The rock would be put in place by dump barge.

1.141 Approximately 106,019 gpm of cooling water would be discharged from the plant. The water would be 12° F above ambient temperatures. Using a thermal plume model developed by Dr. D. W. Pritchard, of Johns Hopkins University, Reserve has calculated that the 3° F isotherm resulting from the discharge would envelop less than 1 acre (exhibit 39).

DELTA STABILIZATION

1.142 Reserve proposes to stabilize the tailings delta along the following conceptual steps:

a. An initial broad dike 5,100 feet long, 25 feet high and 100 feet wide of waste mine rock would be constructed on a line about 600 feet inland from the present lakeside edge.

b. Lake Superior wave action would erode a natural beach on the portion of the delta lying lakeward of the dike.

c. When the tailings beach erosion had progressed sufficiently to permit the waves to reach the dike, the initial dike on the lake side would be flattened by wave action and rock would be spread over the beach.

d. Periodically, mine waste rock would be added along the lakeside face of the dike to add to the protective layer being formed on the beach and to compensate for losses due to changes in water levels. It is not presently known how often this maintenance would be required.

e. Behind tne dike, Reserve proposes to revegetate the delta.

1.143 It should be noted at this point that the proposed heated water discharge system would have to be completed and operational before Reserve could switch to on-land disposal of taconite tailings. Tnis is not the case with delta stabilization.

2.000 ENVIRONMENTAL SETTING

SILVER BAY AREA

Climate

2.001 The climate of the Silver Bay area is primarily determined by its latitude and its proximity to Lake Superior. The area is in the zone of prevailing southeasterly movement of the earth's atmosphere although southerly and northerly winds frequently occur. During the winter season, northerly winds are very common with frequent outbreaks of cold polar air. During the summer the area is just north of the mean path of warm, moist air from the Gulf of Mexico and the southwest United States. Summers are usually mild with a few periods of warm and humid conditions.

2.002 Approximately 60 percent of the annual precipitation occurs during the months of May through September, with the drier periods extending from November to March. Seasonal snowfall averages approximately 70 inches in the area, nearly 30 percent greater than other areas of the State. The heavier snowfalls are due to occasional northeast winds in which moisture-laden air from Lake Superior provides precipitation.

2.003 Average annual precipitation for the area is 28.85 inches (Two Harbors station). Utilizing precipitation records from 1906 to the present, indications are that only 2 percent of the time will the annual precipitation exceed 40 inches per year and 98 percent of the time it will exceed 15 inches per year. The maximum rainfall for a 24-hour period occurred during August 1939; a total of 5.25 inches fell in the Two Harbors area. Tech. Paper No. 40 (U.S. Weather Bureau) estimates that the 100-year frequency, 24-hour duration rainfall for the area is 5.08 inches. The maximum probable precipitation in 6 hours for a 10-square mile area would be 22 inches.

2.004 Winds tend to prevail from the northwest much of the year with easterly winds prevailing in late spring and early summer. Wind speeds average 10 to 12 miles per hour year-round.

2.005 Mean monthly temperatures range from a low of 14.8° F in January to 65.3° F in August (Two Harbors station). Winter temperatures occasionally drop to the -20° F range while summer highs may exceed 90° F. However, Lake Superior tends to moderate temperature extremes at Silver Bay.

Air Quality and Stability

2.006 Ambient air quality in the Silver Bay area has only been tested for total suspended particulates (TSP) and fibers. Reserve has sampled for TSP at seven stations in the Silver Bay area since 1971 and at 12 stations since 1974. The annual geometric means have ranged from 18 to 48 ug/m^3. (The State and Federal primary standard is 75 ug/m^3 and the secondary standard is 60 ug/m^3.) However, some of the stations have recorded concentrations exceeding the maximum 24-hour concentration prescribed by the primary standard (260 ug/m^3). (See table 2.)

2.007 Sampling for airborne fibers was conducted on four occassions from December 1974 to August 1975. The results of the sampling were sent to different laboratories for analysis. The results are shown in table 3. As can be seen from the data, there is a wide variation among laboratories. The MPCA believes the data arrived at by the Mt. Sinai, Minnesota Health Dept., and the Environmental Protection Agency Water Quality Lab to be the most accurate, based upon procedures used by the various laboratories.

2.008 The meteorological factors that affect the transport and dispersion of air pollutants can be referred to as the "air pollution potential." The method by which effluents diffuse is primarily a function of the stability of the atmosphere along with wind speed at ground level. The atmospheric stability determines the amount of vertical and lateral mixing or dispersion of air pollutants as they are carried away from their sources by the wind. An important factor that affects the rate of diffusion of air pollutants is associated with atmospheric turbulence and by a mixing height which is the upper level of the meteorological boundary layer.

2.009 In regard to air movements and mixing heights, the presence of Lake Superior can influence considerably the dispersion of airborne pollutants. For example, in the late spring the neighboring large bodies of water are still cold relative to the adjacent land masses. This difference will be greatest during mid-afternoon due to the rapid solar heating of the land mass. If the general wind flow results in a long passage of air over water and is blowing towards shore, the air will cool and cause an inversion in the air reaching the shoreline. Air pollutants released into the air stream will usually spread horizontally but rarely, if at all, vertically. The practical result is that pollutants will tend to sink and remain at ground level in these periods of inversion.

Table 2

RESERVE AIR QUALITY MONITORING SYSTEM
MEASUREMENTS IN EXCESS OF MPCA STANDARDS
1 SEPTEMBER 1973 - 31 AUGUST 1976

Station	Standard $\mu g/m^3$	#Violations	Range ($\mu g/m^3$)	Mean ($\mu g/m^3$)	Median ($\mu g/m^3$)
#1	150[a]	7	166-211	177	173
#2	260[b]	9	274-458	321	305
	150	55	152-256	194	195
#3	150	5	151-210	177	173
#4	260	9	273-761	402	385
	150	48	153-249	191	192
#5	150	12	152-232	182	186
#6	260	5	277-500	376	373
	150	21	151-251	169	178
#7-9	No Violations				
#10	150	1	156	156	156
#11-12	No Violations				

a. Secondary standard - max. 24-hour conc.
b. Primary standard - max. 24-hour conc.

TABLE 3

AIRBORNE FIBER LEVELS IN SILVER BAY

Sample #	Location in Silver Bay	Date	Laboratory Results Amphibole Fibers/(meter)^3: Mt. Sinai	EPA-WQL[1]	Health Dept.	ITTRI	ADL[2]
7144A	Campton School	8/21-28/75	335,000	262,000	390,000	5,900	3,200
7144B	McDonald School	8/21-28/75	164,000	235,000	177,000	2,700	5,400
7144C	Kelly School	8/21-28/75	323,000	178,000	174,000	3,000	6,600
9040	Campton School	5/21-29/75	384,000	513,000	450,000	3,900	12,800
9041	McDonald School	5/21-29/75	502,000	448,000	351,000	2,500	6,100
9042	Kelly School	5/21-29/75	583,000	516,000	569,000	800	6,200
9061	Campton School	3/31-4/10/75	53,000	33,000	67,000	1,000	1,600
9062	McDonald School	3/31-4/10/75	358,000	71,000	112,000	5,800	12,400
9063	Kelly School	3/31-4/10/75	240,000	76,000	120,000	600	3,800
4221	Campton School	12/2-9/74	252,000	158,000	138,000	4,400	10,400
4222	McDonald School	12/2-9/74	100,000	99,000	96,000	1,400	8,000
4223	Kelly School	12/2-9/74	394,000	230,000	221,000	3,200	20,000

1 - Environmental Protection Agency - Water Quality Laboratory
2 - Arthur D. Little, Inc.

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2.010 Low level (150 meters) temperature inversions are very common during nighttime hours in northeastern Minnesota, occurring 50 to 60 percent of the time. During warm weather, the heat sink created by Lake Superior substantially increases the frequency of temperature inversions along the lake shore.

2.011 Because the terrain of the area consists mainly of low rolling hills, there is little chance of air trapping due to canyon effects. Also the mean wind speed of almost 12 miles per hour (Little, 1975) tends to increase the dispersion rate of emitted pollutants in the area and thus minimizes the ambient concentration of the area.

Socio-Economic Environment

2.012 Silver Bay has grown up as a company town around the Reserve plant which was constructed there in the early 1950's. The residential areas have tended to spread out as there is plenty of land available. The commercial community is located primarily along U.S. Highway 61 and its adjacent blocks. Silver Bay became incorporated as a village in 1965 and is administered by the mayor-village council system of government. The present census of Silver Bay shows a population of 3,405.

2.013 Silver Bay has the facilities customarily found in towns of comparable size for educational, religious and recreational life of their residents. Most of the homes are single-story, three-bedroom structures with full basements. More than 95 percent of the homes are privately owned. The public schools are of high quality, and the community has excellent recreational facilities. The health care for the community is considered adequate, with Duluth having the most convenient hospital facilities. Silver Bay maintains its own fire and police departments and water and sewage systems.

2.014 About 62 percent of the employees working at Reserve's Silver Bay plant live in Silver Bay. The remainder commute from neighboring communities, primarily Two Harbors (18.6%), Finland/Little Marais (7.2%), Beaver Bay (5.4%), and Duluth/Superior (5.2%). In addition to the 1,432 people employed at Silver Bay, Reserve also employs 1,640 people at their Babbitt site (mining and primary crushing operations).

2.015 The importance of Reserve's employment to the economy of the area is reflected by the fact that nearly 80 percent of the labor force in Silver Bay and 65 percent in Babbitt are directly employed by Reserve. When indirect (and induced) employment - that supported by purchases of Reserve and spending by its employees is taken

into account, virtually the entire labor force in Silver Bay and at least 75 percent of Babbitt's are attributable to Reserve's operations. Wages earned directly and indirectly which are attributable to Reserve in Silver Bay amount to nearly $15 million and to more than $10 million in Babbitt.

2.016 Within the commuting area of Silver Bay and Babbitt, Reserve has a dominant economic influence. For example, in the area of Two Harbors, Beaver Bay, and Little Marais, it is estimated that more than half of the employment is attributable to Reserve. Total income earned by people in the Silver Bay area whose employment is directly and indirectly attributable to Reserve amounts to nearly $22 million. In the Babbitt-Ely area, nearly 60 percent of all employment is attributable to Reserve, and total wages earned amount to more than $20 million.

2.017 Reserve accounts for more than one-fourth of the employment in the taconite industry in the State. Total wages directly and indirectly resulting from Reserve's operations amount to $68 million annually. Most of this is earned by people living in the vicinity of Silver Bay, Babbitt, the Iron Range, and Duluth.

2.018 Mining and processing taconite to produce iron-rich pellets requires the purchase and consumption of substantial quantities of materials, supplies, and services. Many of Reserve's suppliers are located in Minnesota. Reserve reports spending $50.66 million on such purchases during 1974. Of this total, $36.8 million--about 73 percent--was spent in Minnesota. These purchases plus those of Reserve employees support employment in other sectors or industries of the economy, especially at the local and regional level. The taxes paid by Reserve and its employees also support employment in the public sector of the economy. The generation of this additional employment by the economic activities of Reserve and its employees is analyzed and estimated by the determination of the employment "multiplier"--an estimate of "indirect" and "induced" jobs in the total economy that can be economically linked to direct economic inputs and activity. A study of the regional economy concluded that approximately one job is generated for every mining job in the region. Thus, Reserve Mining operations could be generating up to 3,000 additional jobs in other sectors of the economy, with the associated income, spending, and taxes from such employment.

2.019 In addition to the usual economic effect attributable to any operating company, Reserve has participated in other affairs of local, regional, State or national concern and interest. Corporate donations totaling about $41,000 in 1974 were primarily directed to local and regional community affairs. One-third of the total was used for scholarships. Reserve spent $109,600 on membership dues in 1974.

2.020 During 1971-1973 the direct operating cost of Reserve's existing mining and processing facilities ranged from about $8.05 to $8.80 per long ton of pellets produced. The total operating cost incurred, including State taxes, royalties, interest, depreciation, and other adjustments, ranged from about $12.20 to $12.60 per long ton of pellets produced. During this period, the price of Reserve's pellets FOB Silver Bay, based on the Lake Erie price (Lake Erie price is the price of pellets accepted by the U.S. Internal Revenue Service and State of Minnesota for tax purposes), ranged from about $15.00 to $15.50 per long ton. The income before depletion and Federal income taxes to Armco and Republic (parent companies) ranged from about $2.35 to $2.90 per long ton of pellets. During 1974 and 1975, the Lake Erie price for pellets increased substantially. Since January 1974, the Lake Erie price has increased from 29.4 cents to the current price of 47.2 cents per long ton unit of natural iron, resulting in a 60-percent increase in pellet prices.

2.021 In mid-1975, Reserve's direct operating costs were $12.13 per long ton of pellets, and the total operating cost incurred was $17.67 per long ton of pellets, as shown in table 4, below.

TABLE 4

ESTIMATED TOTAL OPERATING COST INCURRED FOR RESERVE'S EXISTING MINING AND PROCESSING FACILITIES FOR 1975*

	$/Long Ton Pellets
Pellet Price, FOB Silver Bay	24.478
Mining	
Mine Stripping	Reserve Mining Company claims that publication of the individual components of its direct operating costs would adversely affect its competitive position.
Coarse Crushing	
Rail Haulage	
Fine Crushing	
Concentrating	
Pelletizing	
Works General Expense	
Townsites	
Administration	
Research and Development	
Direct Operating Cost	12.134
Royalties	1.904
State Taxes	1.764
Depreciation	1.228
Interest	0.537
Other Costs and Adjustments	0.098
Total Operating Cost Incurred	17.665

* Average for May through August 1975; Extrapolated from data for the first 4 months of 1975.

TABLE 4 (cont.)

Net Income Before Depletion and Federal Income Taxes	6.813
Depletion	3.407
Federal Taxable Net Income	3.406
Federal Income Tax	1.635
Net Income After Depletion and Federal Income Tax	1.771
Depreciation	1.228
Depletion	3.407
Cash Flow Before Loan Repayment	6.406
Loan Repayment	.803
Cash Flow After Loan Repayment	5.603

2.022 Based on the Lake Erie price, the price of Reserve's pellets FOB Silver Bay is $24.48 per long ton, resulting in income before depletion and Federal income taxes to Armco and Republic of $6.81 per long ton of pellets. Based on pellet production of 10.4 million long tons of pellets, this current income is $70,855,000 per year. Thus, income before depletion and Federal income taxes to Armco and Republic has increased from an average of about $25,000,000 per year for the 1971 to 1973 period to an estimated $70,855,000 for 1975.

2.023 Of major importance to Armco and Republic is the amount of cash or cash flow generated by Reserve and available to the parent companies for other uses. Since Reserve is a cost company, Armco and Republic reimburse Reserve only for the actual cost incurred by Reserve in producing the pellets. If Armco and Republic were to purchase Reserve pellets at the Lake Erie price, the cost of Armco and Republic would be substantially greater than the amount paid to Reserve. The cash flow generated by owning Reserve, and thus available to Armco and Republic, is determined by using the Lake Erie price for Reserve's pellets rather than the actual cost incurred by Reserve. Based on Reserve's mid-1975 costs and the current Lake Erie prices, the amount of cash generated by Reserve after existing loan repayments, and available to Armco and Republic for other uses, is estimated to be $58,300,000 in 1975. This is based on a cash flow, after loan repayment, of $5.603 per long ton of pellets.

LAKESIDE POWER PLANT SITE

Water Resources

2.024 The dominant water resource at Silver Bay is Lake Superior. The Beaver River enters the lake about 2.4 miles southwest of the Lakeside Power Plant while Palisade Creek flows into the lake about 4.5 miles northeast of the plant. An artificial harbor has been created near the power plant by installing a breakwater between the mainland and Beaver Island.

2.025 Lake Superior is characterized by cold temperatures and soft water. Water temperatures in the lake fluctuate slightly, ranging in the 40's most of the year. Hardness is approximately 44 ppm $CaCO_3$, and pH is approximately 7.5. Exhibit 40 contains the chemical characteristics of Lake Superior.

2.026 Shipping has been responsible for some water quality degradation in the open water and harbor areas of Lake Superior. Oil discharges, bilge wastes and garbage from commercial vessels using the lake have created occasional problems in the past. The water quality generalizations made for the open lake are appropriate for most inshore waters. The widespread indications of change and deterioration observable in the inshore waters of the other Great Lakes are, for the most part, not apparent in Lake Superior. There are exceptions, however. These include water quality problems in the Duluth-Superior Harbor and the discharge of taconite tailings at Silver Bay.

2.027 A number of drinking-water supply intakes are located along the north shore. Their locations in relationship to Silver Bay are shown in exhibit 41.

Aquatic Biota

2.028 Fish. A variety of fish species are found in the near shore or harbor areas of Lake Superior. The assemblage of fish is generally comprised of stenothermal "cold water" species (whitefish, trout, etc.), but species are also present which are typically found in warmer water (walleye, yellow perch and northern pike).

2.029 Lake Superior is characterized by the salmonids including lake trout, (*Salvelinus namaycush*), steelhead (*Salmo gairdneri*) and brown trout (*Salmo trutta*), and more recently the coho salmon (*Oncorhynchus kisutch*). The lake trout has been gradually depleted over the years by the sea lamprey (*Petromyzon marinus*) and heavy fishing pressure, but still it has been, and continues to be, the most important sport fish caught in Lake Superior. Present populations are higher than those of the recent past. Lake-run brown trout and rainbows are important and receive heavy fishing pressure during the spring and fall spawning runs.

2.030 Beaver River and Palisade Creek, the two streams on either side of Silver Bay, support spring steelhead runs. The Minnesota Department of Natural Resources surveyed north shore streams with respect to the steelhead fishery in the 1960's and found that the Beaver River has .16 mile of steelhead water and Palisade Creek has 1.19 miles as compared to the average of .60 mile for the 15 streams surveyed. Both the Beaver River and Palisade Creek were lightly fished in comparison to the other streams.

2.031 The Beaver River was stocked with coho salmon in 1970-72 but the attempt to establish a fall fishery has been relatively unsuccessful. Fishermen fish for lake trout and salmon in the nearshore waters around Silver Bay.

2.032 Plankton. The plankton population of Lake Superior is sparse, and dominated by forms characteristic of cold, deep lakes. Recent studies show that diatoms are the most abundant plankton groups. The most abundant of phytoplankton include: *Asterionella formosa*, *Tabellaria fenestrata*, *Melosica granulata*, *Dinobryon* sp., *Synedra acus*, and *Cyclotella* sp. (Beeton, 1965).

2.033 The following zooplankton have been listed (Eddy, 1943) as common in Lake Superior:

rotifers - *Keratella cochlearis* and *Keblicottia longispina*
cladocerans - *Daphnia longispina* and *Bosmina longirostris*
copepods - *Diaptomus minutus*, *D. silcilus*, *Epischure lacustris*, *Limnocalanus marcrurus* and *Cyclops Bicuspidatus*

2.034 Benthos. The amphipod *Pontoporeia affinis*, oppossum shrimp *Mysis reletica*, and the midge-fly genus *Hydrobaenus* are dominant members of the Lake Superior bottom fauna (Beeton, 1965).

Terrestrial Biota

2.035 Vegetation. The areas immediately surrounding the Reserve complex at Silver Bay are covered by second growth deciduous forest with aspen (*Populus tremuloides*) and white birch (*Bethula papyrifera*) dominating.

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2.036 The Lakeside Power Plant site itself has little vegetation on it. Scattered weeds and grasses have taken hold along the buildings and fences. The breakwater leading out to Beaver Island has a lush growth of weeds growing along the road. The tailings delta has little growing on it except some experimental grass and legume plots planted by Reserve employees. Beaver Island, about 6 acres is size, is capped by trees and shurbs. Some of the most common are white birch, mountain ash (Sorbus americana), aspen, wild cherries (Prunus sp.), hazelnut (Corylus sp.) and bush honeysuckle (Diervilla lonicera).

2.037 Wildlife. The Lakeside Power Plant site offers little in the way of wildlife habitat as most of the area is graveled and used for buildings or storage areas. The weed growth along the breakwater and Beaver Island itself offers some habitat for small mammals, songbirds, and gulls (Carus sp.). During the migration season, waterfowl are occasionally seen around Beaver Island and the tailings delta. In the fall, migrating hawks funnel down the ridge along the North Shore, thus providing some of the best "hawk watching" in the U.S.

MILE POST 7 SITE

Geology

2.038 Northeastern Minnesota is underlain exclusively by Precambrian rocks beneath the galcial deposits of several ice invasions. The last glacial advance retreated from the Silver Bay area about 10,500 years ago. The bedrock at Silver Bay is primarily Beaver Bay gabbro of Precambrian age with some extrusive lava flows of the same age. This part of Minnesota is not a seismically active area and the chances of an earthquake are remote.

2.039 The bedrock in the valley floor under the fine tailings portion of the proposed Mile Post 7 site is composed of North Shore Volcanics. The Beaver Bay Complex, a more durable rock than the volcanics of the valley floor, intruded upon the volcanics, forming the east valley wall. The east ridge, which is part of the Beaver Bay complex, is characterized by a thin soil layer and frequent rock outcroppings. The west ridge area has few outcrops; but in general, it is believed to be underlain by North Shore Volcanics and minor intrusives.

Mineral Potential

2.040 As mentioned above, the Mile Post 7 site is underlain partly by mafic intrusive rocks (Beaver Bay Complex) and partly by intrusive and extrusive igneous rocks which are probably part of the North Shore Volcanic group. The intrusives of the latter group may have some general potential for copper, but no mineralization has been reported from the site. Non-commercial copper sulfide minerals have been reported some 12 miles to the northeast and a native copper occurrence 10 miles east of the site. No commercial ore bodies have ever been discovered in this area. The copper resource potential of the site is considered low.

2.041 The intrusive mafic rocks of this region contain occasional larger blocks of anorthosite. Such blocks might have long-term potential for aluminum. However, very large masses of anorthosite and suitable clays occur elsewhere in Minnesota and the rest of the United States where they would be more easily mined. The operating and capital cost estimate for aluminum production from anorthosite is nearly double the costs for aluminum from bauxite. The cost to produce aluminum from clay is nearly as high as from anorthosite. No large blocks of anorthosite are known to occur at the site, and if any do occur, they are covered by the glacial till and lake clays.

Soils

2.042 The soils on the Mile Post 7 site were primarily derived from glacial till and Lake Superior clays. Glacial tills are of three basic types: gravelly sandy loam (10 percent of the site); sandy loam till (10 percent of the site); fine sandy loam (20 percent of the site).

2.043 About 30 percent of the site is covered by the Lake Superior clay. The soils are over 80 percent clay, being finer than 2 micrometers in grain size, with illite being the most abundant clay mineral. Peat soils also cover about 30 percent of the site. These soils are formed from the accumulation of undecomposed vegetation material in wetland areas. Reed-sedge with a high percentage of wood fiber is the most common type of composition. These soils are generally low in fertility and very acidic in character.

2.044 The U.S. Soil Conservation Service has, based upon soils present on the site and slopes, determined that 795 acres of the Mile Post 7 site are potential prime agricultural land. On the Mile Post 7 site this land is in reality prime forest land (exhibit 50).

Water Resources

2.045 The Mile Post 7 site lies entirely in the Beaver River watershed. The Beaver River watershed, tributary to Lake Superior, has a total area of approximately 131 square miles. The watershed appears to be typical of many of the short streams directly tributary to Lake Superior along the North Shore. The terrain can be described as rugged with relatively steep gradients which produce rapid runoff in response to heavy rainfall. Storage areas such as marshes, which slow the rate of runoff within the watershed, are limited, probably within the range of 10 to 20 percent of the total area. The stream network within the Beaver River watershed consists of a rather complex array of small channels and tributaries to the Beaver River, and its west and east branches.

2.046 Immediately adjacent to the site is Bear Lake. Bear Lake is a relatively small lake a little over one-half mile long and less than one-fourth mile wide. The lake has no active outlet or tributary streams. It drains into the proposed tailings basin site via an intermittent creek.

2.047 The limits of the existing local ground water basin at the Mile Post 7 site are roughly defined by the local surface watershed boundary. The lake clays and glacial till found in the basin area have permeabilities on the order of 10^{-7} to 10^{-9} centimeters per second (.01 to .0001 feet per month). Permeabilities on the order of 10 to 100 times higher may exist in the 1- to 3-foot thick zone at the top of the existing bedrock surface which is highly fractured. As a result of these low permeabilities, groundwater movement toward local sinks, such as streams, is extremely slow. Groundwater levels in portions of the basin which have lake clays are difficult to determine because of the extremely low permeability. It is probable, however, that the lake clays are generally saturated to within 5 feet of the surface. In areas where bedrock is close to the surface, groundwater levels are near the surface due to the impermeable nature of the bedrock.

Water Quality

2.048 Water quality in the Beaver River and its tributaries is good. Water quality data for the Mile Post 7 site have been collected both by Reserve and Midwest Research Institute for the State of Minnesota. These data are on file in the St. Paul District Office, Corps of Engineers. The streams are neutral in pH, low in dissolved solids, and well oxygenated. As the watershed is undeveloped, sources of pollutants are almost non-existent. Nutrient input orginates in natural sources.

Aquatic Biota

2.049 The aquatic habitats at the proposed Mile Post 7 site are listed in table 5 below:

TABLE 5

Aquatic Habitats - Mile Post 7 Site

Water Body	Classification	Species of Major Importance	Major Substrates	Benthic Organisms
Beaver River	Trout-minnow Cold water	Rainbow trout Brook trout Brown trout Minnow sp.	Gravel Boulder Rubble	Clean Water Indicators
Big thirty nine Creek	Trout-minnow Cold water	Brook trout Creek chub Minnow sp.	Sand Detritus Gravel	Clean Water Indicators
Cedar Creek	Trout-minnow Cold water	Not Sampled	Not sampled	Not sampled
Bear Lake	Clear cold Deep water	Smallmouth bass Yellow perch White sucker	Sand Gravel Rubble Muck	Clean Water Indicators

2.050 Based on surveys conducted by the Minnesota Department of Natural Resources (DNR), the State has designated most streams in the Mile Post 7 area as trout streams. Fishing pressure on the streams varies directly with accessibility. The lower section of the Beaver River has convenient access points and therefore is heavily fished. Access to the upper reaches of most streams is extremely difficult, afforded only by a few trails and old railroad grades.

2.051 The Beaver River at Avon Falls was sampled by Midwest Research Institute for the DNR using the backpack shocker and angling methods. Fish taken in this survey include bluegill (Lepomis macrochirus), brown trout and a number of minnows (Cyprinidae). This area of the Beaver River is easily accessible and the fishing pressure is extremely high. The east branch of the Beaver River contained a variety of fish, including brook trout (Salvelinus fontinalis), creek chub (Semotilus atromaculatus), blacknose dace (Rhinichthys atratulus), longnose dace (R. cataractae), mottled sculpin (Cottus bairdi), and shiner (Notropis sp.).

2.052 The Beaver River basin provides a variety of habitats capable of supporting a population of fish including brook and brown trout. The requirements necessary for a suitable trout habitat are readily available including adequate food production (terrestrial and aquatic insects, minnows), suitable substrate (sand, gravel and rubble), clean moving water, and low water temperatures.

2.053 Approximately 7 miles of Big Thirty-Nine Creek, 2.7 miles of Little Thirty-Nine Creek (its major tributary) and a few small feeder streams fall within the boundary of the proposed tailings basin. Big Thirty-Nine Creek is a designated trout stream but is only lightly fished due to poor access. Typical bottom types within these creeks include sections of gravel, boulder, rubble, and silt over clay, the latter predominating in the lower sections. Fish collected from this area include brook trout, white sucker (Catostomus commersoni), and a number of minnows.

2.054 Bear Lake is privately owned and lies adjacent to the eastern edge of the proposed Mile Post 7 tailings basin. It occupies 39 acres and is just over one-half mile long and under one-fourth mile wide. It is a clean, clear, soft-water lake and reported to be as much as 60 feet deep. Almost the entire shoreline is comprised of rock, gravel and sand. Thus the number of aquatic macrophytes is very low.

2.055 Rock and gravel form the characteristic bottom substrate to a depth of approximately 20 feet (varying with slope), with mud and detritus found at greater depths. Dredge samples taken in the mud and detritus show a considerable diversity of benthic organisms. If the sand and gravel bottoms were sampled they would yield a number of additional species.

2.056 Fish were collected from Bear Lake using a gill net for 7 hours. Three species of fish were collected: smallmouth bass (Micropterus dolomieui), yellow perch (Perca flavescens) and white sucker. A number of minnow species were observed; however, none were collected. Bear Lake is an unusually clear lake offering a quality habitat for its resident fishes and is capable of supporting a number of other fish species including trout.

2.057 Aquatic sampling data for the Mile Post 7 site are on file in the St. Paul District Office, Corps of Engineers, and available upon request.

Terrestrial Flora

2.058 Vegetation present on the Mile Post 7 site has resulted from a combination of significant influences: site conditions, fire, and early logging. Sites vary from dry rock outcrops with little soil to deep moist clay soils to wet organic bog conditions. Fires have burned parts of the area repeatedly, particularly following the heavy cutting of pine, cedar, and tamarack logs and their removal by railroad during the period 1900-1910. There are no indications of major fires occurring on the site within the last 40 to 50 years. The vegetation present is the result of natural regeneration following the fires and timber removal.

2.059 The vegetation on the site has been sampled thoroughly both by the Midwest Research Institute for the State of Minnesota and by consulting firms for Reserve. The vegetation analysis of A.D. Little (1975) is presented in exhibit 42. Most of the site is covered by aspen and white birch either singularly, in combination with each other, or in combination with other tree species. Most of the aspen and birch on the site are mature trees. There are no areas on the Mile Post 7 site that show any signs of logging having occurred for the past 7 to 8 years.

2.060 Other common forest types found on the site include lowland brush, balsam poplar (*Populus balsamifera*), sugar maple (*Acer saccharum*), and black ash (*Fraxinus nigra*).

2.061 The hardwood types on Mile Post 7 contain generally mature to overmature stands of timber ranging in volume from 5 to 30 cords[1] per acre. These stands would be suitable for cutting pulpwood; however, relatively little of the timber volume is in saw timber size and quality. The softwood types are also overmature and suited for pulpwood. Access for logging much of the area is difficult or non-existent.

2.062 On 16 June 1976 the U.S. Department of the Interior published a list of plant species that they proposed for endangered status under the Endangered Species Act. One of the listed species, *Polemonium occidentale* var. *lacustre*, is found in northeastern Minnesota. The only place this variety of herb has been found is in a white cedar swamp about 90 air-miles northwest of the Mile Post 7 site.

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(1) 1 Cord = 128 cubic feet of wood

Terrestrial Fauna

2.063 Regional. The Mile Post 7 site lies in an area of northeastern Minnesota that may be classified as northern boreal forest. However, due to fire and human disruption, major habitat types represented are early to mid-successional mixed conifer/hardwood communities. Northeastern Minnesota has few amphibians and reptiles with only twelve species and five species represented respectively. Four species of salamanders, eight species of frogs and toads, three snake species, and two turtle species have geographic ranges which include northeastern Minnesota. Among the more familiar species are the green frog (*Rana clamitans*), wood frog (*Rana sylvatica*), American toad (*Bufo americanus*), western painted turtle (*Chrysemys picta*), snapping turtle (*Chelydra serpentina*), and western garter snake (*Thamnopolis sirtalis*). They are important in the food web, both as consumers of insects and rodents and as prey species for some predators.

2.064 Northeastern Minnesota contains a variety of landscapes consisting of lakes, streams, bogs, swamps, conifer and hardwood forests, and rocky outcrops. These areas provide habitat for a large number of birds. Approximately 229 species of birds are found in the area during some seasons of the year. There are 30 species which are year-round residents, and 143 other species breed in the area. The remainder are either winter residents or migrants. There are 38 species which are considered game birds and are hunted in some part of their range. Included in this number are 24 species of water-fowl, woodcock (*Philohela minor*), and snipe (*Capella gallinago*).

2.065 The mammalian component of the biota is composed of 51 species. Seven of these are considered game animals and 15 are furbearers. The other mammaliam species present are primarily small rodents, shrews and bats. Many of the rodents are a primary food source for some of the furbearers, game species and raptorial birds.

2.066 There are two animal species in northern Minnesota which are classified as nationally endangered: the peregrine falcon and the eastern timber wolf (see exhibit 43). The peregrine falcon (*Falco peregrinus*) passes through this area on its spring and fall migration while the eastern timber wolf (*Canis lupus*) is a permanent resident. Although the eastern timber wolf is on the Federal endangered species list, it is considered a "species of changing or uncertain status" by the State of Minnesota.

2.067 The wolf population remained fairly stable from 1966-1971, but started a decrease in 1972. The latest estimate for the spring of 1973 indicates a population level of one wolf per 14.7 to 16.4 square miles. The successional trend toward forests of increasing age is detrimental to deer populations, the primary food source of the wolf. This in turn places stress on the wolf population which may necessitate use of alternate or supplemental food sources. Recently, northern Minnesota residents have reported a rise in wolf populations which has led the State to ask the Department of Interior to remove the wolf from the endangered status list for Minnesota.

2.068 Minnesota lists 64 species of animals which merit special consideration. There are 21 species, excluding fish, which may be found in northeastern Minnesota:

TABLE 6

SPECIES STATUS

Endangered Species

Peregrine falcon

Threatened Species

Pine martin
Bobwhite
Greater sandhill crane

Species with Changing or Uncertain Status

Fisher
Eastern timber wolf (nationally designated as endangered species)
Canada lynx
Northern bald eagle
Osprey
Marsh hawk
Cooper's hawk
Double-crested cormorant
Franklins's gull
Common tern

Species of Special Interest

Bobcat
Common loon
Great blue heron
Pileated woodpecker
Snapping turtle
Redback salamander
Central newt

2.069 In addition to the State and Federal listings, the National Audubon Society maintains a Blue List for birds which is intended to give early warning of apparently non-cyclical population declines. Eighteen of these species have ranges which include northeastern Minnesota (table 7).

TABLE 7

BLUE-LISTED SPECIES HAVING RANGES WHICH INCLUDE NORTHEASTERN MINNESOTA

Red-necked grebe	Kestrel
Double-crested cormorant	Piping plover
Black-crowned night heron	Upland sandpiper
Canvasback	Yellow-billed cuckoo
Cooper's hawk	Common nighthawk
Sharp-shinned hawk	Hairy woodpecker
Marsh hawk	Purple martin
Osprey	Yellow warbler
Merlin	Grasshopper sparrow

2.070 Common game species of this area include: ruffed grouse (Bonasa umbillus) spruce grouse (Canachitus canadensis) snowshoe hare (Lepus americanus), black bear (Ursus americanus), moose (Alces alces), and white-tailed deer (Odocoileus virginianus).

2.071 Mile Post 7 Site. All of the common game species occur on the Mile Post 7 site. There are no data available as to specific population levels for any species on the site. The site contains habitat preferred by most songbirds and mammals but has little habitat value for waterfowl, shorebirds, and some of the raptors.

2.072 The site has been rated for habitat quality for some game species (Little, 1975). The site is rated fair to poor for moose primarily because of a lack of adequate acreage of lowland brush for year-round food supply, dense conifers for winter cover, wet meadow, and open water.

2.073 The site is rated fair for whitetail deer. While there is adequate summer forage available, there is a lack of adequate winter cover (dense conifer stands) with adequate winter browse. Much of the existing browse (hazel, red, sugar and mountain maple) has grown beyond the reach of deer and is no longer available for winter use.

2.074 The site was rated fair to poor for ruffed grouse primarily because of the maturity of the aspen and birch stands and the lack of mixed age classes in these stands. The site was rated as poor for spruce grouse due to the lack of adequate acreages of black spruce.

2.075 The site is rated as good for woodcock. It has adequate cover and food, and the openings preferred by woodcock for breeding.

2.076 The peregrine falcon, an endangered species, could possibly use the Mile Post 7 site. Preferred nesting sites are ledges in the face of a cliff; tne ridge along the east edge of the Mile Post 7 site might possibly serve as a nesting site for this species. There was no evidence of nesting there at the time of the 1974 survey. These birds have been observed migrating along the North Shore near Duluth. Discussions witn local hunters and outdoorsmen indicate that they have never seen the peregrine falcon in tnis area. Tnis view is also corroborated by the University of Minnesota Department of Wildlife (Little, 1975).

2.077 The primary wolf range in Minnesota occurs in the northernmost portion of the region as generally outlined by the southern border of the Superior National Forest. The Mile Post 7 site is south and east of known wolf pack ranges, and lies at the periphery of the range where individual wolves dispersing from packs will occasionally be observed. However, Mile Post 7 does have habitat that could be used by wolves, and the Department of the Interior has answered wolf complaints at Beaver Bay, 2 miles south of the Mile Post 7 site.

2.078 The next most important category on the Minnesota list is the "Threatened Species." Of this group only the pine marten may nave reinvaded this far south, but this is unlikely.

2.079 The third most important category is the "Species of Changing and Uncertain Status." Tnis includes the fisher (Martes ponnati) bald eagle (Haliaeetus leucocephalus), Canada lynx (Lynx canadensis), and osprey (Pandion haliaetus), all of which may occur in the Mile Post 7 area. The two birds probably do not nest in the site due to lack of suitable aquatic habitats. The Canada lynx may occur occasionally in this area. Good fisher habitat does exist in the area, and the fisher is relatively common there. However, a density of one fisher per square mile would be high for this species.

2.080 The lack of suitable aquatic nabitats would suggest that two of the three birds of the "Special Interest" category on the Minnesota list are not commonly found in this area. These are the great blue heron (Ardea herodias) and common loon (Gavia immer). Also on this list is the pileated woodpecker (Dryocopus pileatus), which probably occurs in low numbers due to the lack of large decaying trees.

Land Use and Recreation

2.081 Land Use. The proposed Mile Post 7 site is presently in a natural state and exhibits few human facilities or activities other than those associated with testing for the proposed action. There are no occupied structures on the site, and only one (a summer home) within the area of possible visual or noise-level impact. The major

impacts of human activities took place around the turn of the century when the site was logged and a railroad line was built. Since that time the site has been left to natural forces. Reserve has cleared access roads on the site to facilitate soil borings and other tests. A power transmission line also crosses part of the site.

2.082 Recreation. Snowmobiling is actively carried out in the Silver Bay area in winter. There is an extensive network of some 70 miles of regularly maintained trails in the vicinity of Silver Bay. The Mile Post 7 site contains two snowmobile trails totaling 8 miles. Approximately 4 miles of the North Shore Trail (which is used for hiking and snowmobiling) passes through the site.

2.083 Big Thirty-Nine Creek is designated trout stream but it receives little fishing pressure. The Beaver River is heavily fished, primarily downstream of Avon Falls (approximatley 5 miles upstream from the mouth of the river).

2.084 Use of the project area has been low due to the swampy and brushy nature of the terrain and the proximity of an abundance of more desirable recreational land, and comparatively difficult and limited access. Current estimates of recreation usage indicate twenty to thirty people hunt and fish in the project area annually.

2.085 Split Rock State Park and Baptism River State Park lie respectively 4 and 8 miles from the site. The proposed Tetagouche State Park would be 4 miles east of the Mile Post 7 site, and Lake County is proposing a recreational area 2 miles east of the site.

Cultural Resources

2.086 In compliance with Section 106 of the National Historic Preservation Act of 1966 and Executive Order 11593, the National Register of Historic Places has been consulted and as of 22 March 1977 there are no listed sites in the project area. The Nationally Registered Split Rock Lighthouse and the Edna G. Tugboat will not be affected by the project. It has also been determined that no properties listed on the National Registry of Natural Landmarks are in the project area. The State Historic Preservation Officer has reviewed the permit applications for the proposed discharge pipe on Beaver Island and the Mile Post 7 tailings disposal basin and has requested that surveys be conducted prior to construction of the projects (exhibit 44).

2.087 The Minnesota Historical Society conducted a thorough literature and record review for the alternative on-land taconite tailings disposal sites. The following information briefly summarizes the recommendations contained in that report, entitled "Survey of Written Historical Sources on (1) Mile Post 7 Site, (2) Midway Site, (3) Snowshoe Site (4) Embarrass Site (5) Colvin Site." There are no recorded prehistoric sites in any of these disposal areas; however, the areas have never been surveyed for archaeological remains, so there is a strong possibility of presently unknown prehistoric sites existing in a relatively undisturbed condition. The Dakota and Ojibway are known to have inhabitated the region; the remains of one Ojibway camp have been recorded in the Embarrass area. The French fur traders ventured into the tip of Lake Superior as early as the 1650's. They were followed by the

British and then the American traders. Although no fur trading posts are recorded for any of the disposal areas, British and American posts were established on Lake Vermillion, near the Embarrass site. There are a number of recorded canoe routes and overland trails passing near or through the study areas, which increases the possibility of locating cultural remains. One such trail, the Greenwood, passes through the Mile Post 7, the Midway, and Snowshoe disposal sites. In or near several of the disposal sites there are homesteads dating from the initial settlement of the areas and remains of the early lumbering and railroad activities are also still in existence.

2.088 The State Historic Preservation Officer has reviewed the permit applications for the Mile Post 7 disposal site and the discharge pipe on Beaver Island and has requested that a survey for prehistoric and historic remains be conducted prior to construction. We concur with the recommendations of the State Historic Preservation Officer, that a survey will have to be conducted of Mile Post 7 or the selected disposal site and the impact areas on Beaver Island. It is our further determination that all other areas which will be affected by the proposed construction activities will have to be surveyed by a qualified archaeologist before decisions can be made regarding the issuance of the necessary permits.

Land Ownership

2.089 Approximately 9,130 acres would be involved in the project. Reserve currently owns or controls 3,115 acres of this total. Exhibit 45 contains a map showing the land ownership at the Mile Post 7 site.

3.000 RELATIONSHIP OF THE PROPOSED PROJECT TO LAND USE PLANS

3.001 Land use patterns in Silver Bay have been based almost entirely on Reserve's actions. Before Reserve built its taconite operations at Silver Bay there had been little human influence on the site. The town of Silver Bay grew up around the plant as a company town which it essentially still remains.

3.002 Silver Bay has developed in an orderly fashion. As there is plenty of land available, the town has tended to spread out rather than become congested.

3.003 The industrial, residential, and commercial areas have tended to remain in the same usage as when Reserve first developed the site in the 1950's. The proposed modifications to the taconite plant and the power plant are compatible with the present industrialized use of the site.

3.004 The Mile Post 7 site is presently in a natural state and is used for recreational purposes by hunters, hikers, and snow-mobilers. Fishing use on the site is low because of inaccessibility and limited opportunities. Until Reserve proposed to use it as a tailings disposal basin, the site was not part of any known land use plan.

3.005 The State of Minnesota is currently preparing a Coastal Zone Management Plan for the North Shore. It is scheduled for completion in June 1977. The Coastal Zone Management Plan is being developed with the assumption that Reserve would remain in Silver Bay and with the recommendation that the recreation industry be further developed in Lake County to act as an economic stabilizer.

4.000 PROBABLE IMPACTS OF THE PROPOSED ACTION

COOLING WATER DISCHARGE SYSTEM

4.001 Modification of the cooling water discharge system of the Lakeside Power Plant would have to be accomplished before Reserve could switch to on-land disposal of taconite tailings. Construction of the discharge system would begin as soon as possible following the granting of necessary Federal and State permits.

Construction Impacts

4.002 The construction phase of the proposed project would cause a temporary disturbance to both aquatic and terrestrial habitats. During the installation of the on-land portion of the proposed discharge pipe and diffuser, weeds, shrubs and trees along the right-of-way for the pipe would be removed. This would have only minimal effects as the proposed route is relatively free of trees and shrubs already; however, removal of the vegetation would increase the potential for soil erosion during construction. After construction, Reserve may allow only herbaceous growth near the pipeline, to facilitate ease of maintenance.

4.003 If construction on Beaver Island took place during the nesting season, it could disturb any songbirds and gulls nesting on the island.

4.004 Dredging of the 2,000 cubic yards of material from Lake Superior would cause some temporary turbidity above ambient levels. The existing tailings delta, to which tailings are dischared daily, is immediately up-drift of the site of the area to be dredged; therefore, some ambient turbidity is assumed to exist in the area. Reserve anticipates that the material to be dredged would be fine tailings and clay.

4.005 Reserve proposes to dispose of the material in a diked area on the existing tailings delta. The return water from the disposal area would be required to meet State water quality standards. The impact upon Lake Superior would be negligible.

4.006 Placing the mine rock in the lake to construct the support berm could cause some temporary turbidity from bottom disturbance and cover benthic organisms not removed by the dredging. A permit from the Corps, if issued, would be conditioned to insure that the mine rock be clean and free of fines and other potential contaminants. The water quality impacts associated with this construction would be negligible.

4.007 Construction of the discharge system is expected to cost $850,000 and take 6 months to install. Construction materials and some labor would be imported from outside the Silver Bay area. Some services would be provided by the local economy during the construction period. Those people engaged in providing food, lodging, and garage facilities would receive the benefits of the temporary additional business.

Operation Impacts

4.008 Once in place, the mine rock berm would provide a different type of substrate in an area that is covered by fine tailings and not highly productive biologically. The presence of the berm would provide some niches for aquatic organisms that do not presently exist in the area. This would have a minor beneficial impact upon the aquatic food chain and the diversity of species in the area.

4.009 Maintenance activities along the pipeline would be infrequent and would have little impact.

4.010 The largest single factor of the proposed action would be the discharge of 106,019 gpm of ΔT12° F(1) cooling water into Lake Superior. With the proposed action, only non-contact water would be discharged. Thus the parameter of water temperature is the salient concern. The thermal plume would not meet the lake bottom so there should be no disturbance of sediments by the plume.

4.011 Lake Superior, being a large, cold body of water, is an ideal place, from the standpoint of engineering, for power plants to easily dispense of waste heat. Reserve has designed its discharge system to take advantage of this characteristic. The proposed discharge system was designed for the rapid mixing of the heated discharge water with the ambient cold waters of Lake Superior. Reserve has calculated that the 1° F and 3° F isotherms of the discharge plume would envelop about 1 acre and one-tenth acre, respectively, for a 12° F discharge (exhibit 39).

4.012 The thermal discharge would have little or no impact on adult fish as they would avoid the plume if it were causing them thermal stress. At some power plant discharges in cold climates, fish have been attracted to the warm discharge water in the winter and were then killed by cold shock when the plants were suddenly shut down due to mechanical problems. This phenomenon has been more common to power plants using a discharge canal for cooling, and should not be a problem with the Reserve proposal, which does not include a discharge canal. It is unlikely that fish would congregate at the discharge point due to the energy they would need to expend to maintain their position against the force of the discharge (12 fps). If fish were to congregate in the area of the 3-5° F isotherm, a sudden drop of 3° to 5° F due to plant shutdown would not cause cold shock problems.

4.013 Fish larvae and eggs are essentially planktonic and subject to the influence of currents. The proposed discharge structure is not near any areas that would be considered spawning habitat for Lake Superior fishes. However, if the proposed discharge system were installed, the rock berm supporting the discharge pipe could possibly be used as a spawning site by fish. (Lake trout have been observed spawning on rock riprap covering a thermal discharge pipe at Marquette, Michigan.) If spawning did occur, fish larvae could be drawn into the thermal plume and subjected to thermal stress.

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(1) Δ = increased by

4.014 Currents would draw plankton into the thermal plume where they would be subject to some thermal stress. Due to the small size of the plume this is not anticipated to be a significant impact. Also, since the thermal plume would not impinge upon the bottom of the lake, the discharge should have no effect upon benthic organisms.

4.015 The slight warming of the water in the thermal plume could stimulate increased plankton productivity in the plume. It is doubtful that such an increase would be sufficient to have any impact other than providing a slight increase in food for higher aquatic organisms.

4.016 If a permit were granted by the Corps for the installation of the proposed discharge pipe, Reserve would still be required to obtain a NPDES permit (see glossary) from the Minnesota Pollution Control Agency (MPCA) for the discharge of the condenser cooling water. The MPCA could require Reserve to undertake a 316(a) demonstration (see glossary) before granting a NPDES permit. At the present time, the MPCA has not made a decision as to the need for a 316(a) demonstration.

4.017 All sanitary wastes from the power plant would continue to be routed to the Silver Bay sanitary sewer system. All other plant waste waters, such as boiler blowdown, floor drains, etc., would be routed to the closed-circuit water system proposed for the taconite processing plant. Thus there should be no water quality impacts associated with disposal of these waste waters.

Continuing Impacts

4.018 Certain environmental impacts occurring with the present power plant operation would continue if the power plant stayed in operation using the proposed once-through cooling system or a closed cooling system (cooling tower).

4.019 An unknown number of planktonic organisms would continue to pass through the power plant, entrained in the cooling water. It is not completely known how these organisms are affected by such action, although they are clearly subjected to both thermal and mechanical stess as they pass through the power plant. Tests were run at two nuclear power plants on Lake Ontario on the effects of plankton entrainment in cooling systems (Storr, 1974). At one plant with about a 10° C (18° F) rise in water temperature across the condensers, mortaility rate for all plankters entrained in the cooling water was 18.3 percent. At another plant with about a 17° C (31° F) rise in water temperature the mortality rate was 25.5 percent. It was also determined that about 20 percent of the mortality was attributed to mechanical stress (Storr, 1974). The rise across the Lakeside plant's condensers would be 12° F. By comparison, plankton mortality should be less than described above.

4.020 Some fish would continue to be impinged upon the intake screen of the power plant. In the past, the only species observed impinged on the screen have been rainbow smelt (Osmerus mordax) during the spawning season.

4.021 Reserve can be required by the MPCA to conduct 316(b) studies (see glossary) on their intake procedure to determine its effects on aquatic life. At the present, the MPCA has not made a decision on whether they will require a 316(b) demonstration by Reserve.

4.022 The power plant would continue to dispense pollutants into the atmosphere. In March 1976, Reserve had the emissions from the power plant tested for particulate emissions. Burning 100 percent coal, Unit 1 emitted 1.57 lbs./MBTU and Unit 2 emitted 1.32 lbs./MBTU. Minnesota regulations allow a maximum particulate emission rate of 0.6 lbs. per million BTU.

4.023 The MPCA will require that Reserve reduce the power plant emissions to meet State standards. At the present no definitive plans have been made; however, there are two basic options open to Reserve. They can install air emission control equipment such as electrostatic precipitators or they can switch to burning fuel oil, which has lower particulate emissions.

Cumulative Impacts

4.024 There is concern about the possible proliferation of steam and nuclear generating plants along the Great Lakes to take advantage of the large supply of cooling water available. There is fear that an ever expanding use of Lake Superior water by the power industry could lead to ecological change in Lake Superior. However, there would be no cumulative impacts associated with the proposed discharge. The distance between existing and known proposed power plants on Lake Superior makes it physically impossible for any other thermal discharge plumes to come in contact with the proposed Reserve discharge. Also, the cooling capacity of Lake Superior makes it impossible for existing and presently proposed thermal discharges to raise the temperature of Lake Superior outside the area of the thermal plumes.

DELTA STABILIZATION

4.025 One of the prime motivating forces for the proposal to use an on-land disposal site for the taconite tailings has been the discovery of fibers in the drinking water supply of the city of Duluth. It has been determined by the U.S. District Court that Reserve Mining Company's discharge into Lake Superior contains fibers and that ingestion of those fibers constitutes a health hazard. The U.S. Court of Appeals held that the discharge is thus potentially hazardous to health. The purpose, therefore, of stabilizing the delta would be to prevent the further release of fibers presently tied up in the tailings delta.

4.026 The proposed plan would allow a portion of the delta to erode away during the stabilization process. Fibers would be released during the erosion process. Reserve has calculated that approximately 4 million cubic yards (5.93×10^6 long tons) of tailings would erode away under the proposed plan. This would be equivalent to 94 days of discharge under present operating conditions.

4.027 Reserve has taken samples from the delta and found the fiber content of the samples to be 0.0112 percent. Thus, erosion of 4 million cubic yards of delta material would release 448 cubic yards (664 long tons) of fibers into Lake Superior.

4.028 Reserve has also sampled the material being discharged from the launders and calculated that they are discharging 287 tons per day of fibers. Thus, the proposed stabilization plan would release the same amount of fibers into Lake Superior as are released by 2 1/3 days of present operations. The impact of this action upon Lake Superior would be negligible in comparison to the amount of fibers already released into the lake.

4.029 Reserve has only sampled the upper portions of the delta for fiber content. Thus it is not known if the 0.0112 percent fiber content holds true for all the material in the delta. The worst case situation would be to have the fiber content of the delta the same as that of the discharge slurry. In that case the fibers released under the proposed stabilization plan would equal about 26,978 long tons (287 tons/day X 94 days).

4.030 The impact of the worst case situation would be more adverse than that if Reserve's predictions are accurate, but still minor in comparison to the amount and impact of the fibers already released into Lake Superior. In either case, Reserve's predicted situation or the worst possible situation, assessing the actual impact of the release of these fibers is impossible. It is not known how many fibers have been released into the lake, nor what their actual effects are (other than representing a potential health hazard), nor how long the fibers remain suspended in the lake before they settle out.

4.031 The use of waste rock from the mine would have no effect on Lake Superior water quality. A permit from the Corps, if issued, would be conditioned to insure that the rock was free of fines and other contaminants before being used to form the stabilizing delta.

4.032 The stabilization dike would provide niches for aquatic and terrestrial organisms that presently do not exist in the area.

4.033 It is believed by coastal engineering experts that stabilization of the delta as proposed would be difficult, and that stabilization without allowing part of the delta to erode away would be impossible.

ON-LAND TAILINGS DISPOSAL

Mineral Potential

4.034 The potential for mineral deposits at the Mile Post 7 site is low. The impact of the tailings basin on future mineral development would not be significant.

Soils

4.035 The soils, except for those excavated for dam construction, would be covered with tailings and their productivity lost.

Vegetation and Terrestrial Habitat

4.036 Initial clearing would remove the vegetation from about 60 percent of the site (exhibit 35). Marketable timber and pulpwood would be salvaged. The remaining vegetation would be disposed of in a manner approved by the Department of Natural Resources. At present, no definitive plans have been made. Reserve proposes to leave stumps and ground vegetation in the basin to minimize potential soil erosion during the construction phase. The most economical and probably most environmentally acceptable manner of disposal would be to leave unusable vegetation in the basin and cover it with the tailings, provided this did not substantially interfere with operation of the tailings basin.

4.037 During the clearing operations, most larger species of wildlife would migrate to areas adjacent to the site. Since these areas are probably at or near their carrying capacity, much of the displaced wildlife would be lost via predation, starvation, winterkill, disease, or stress. With the filling of the tailings pond, the remaining wildlife would either be forced to migrate and suffer the same fate as their predecessors or would be covered by the pond.

4.038 The habitat surrounding the site would be temporarily adversely affected because of the pressure created by a short-term surplus population.

4.039 The process of vegetation clearing and wildlife dislocation and/or destruction would occur periodically during the project life as new areas are cleared and the level of the tailings pond is raised (exhibit 34).

4.040 More reclusive wildlife may be prevented from using habitat adjacent to the tailings basin because of the human activity associated with the operation of the basin.

4.041 As the various lifts of the dams are revegetated with grasses and legumes, a unique food source would be available for some species of wildlife. The benefits of this would be minor.

4.042 At the close of operations the water in the tailings pond would be lowered and exposed areas revegetated. There is ample evidence to show that tailings can be revegetated using intensive agricultural methods. How long the vegetation can sustain itself without human efforts is not known.

4.043 Wildlife usage of the site would depend upon the stage of vegetative growth present. It would probably take 40-50 years for natural succession to return the site to its present state.

4.044 During the 40-year life of the project, the biological productivity of the site would be lost. Following reclamation efforts it would take a substantial number of years, if ever, before the productivity of the site returned to present capabilities.

Wetlands

4.045 Approximately 800 acres of wetlands would be filled by the Mile Post 7 proposal. Most of the wetlands are Types 6, 7, and 8.(1) In the vegetation analysis presented in exhibit 42, these are the areas described as the "Cedar Type," "Spruce-Tamarack Type," "Lowland Brush Type," and portions of the "Lowland Hardwood" and "Meadow" types.

4.046 These wetlands perform the following important functions:

1. General habitat, nesting and rearing sites for terrestrial and semi-aquatic wildlife
2. Food chain production
3. Storage area for storm waters

The filling of the wetlands would destroy their ability to perform the above functions.

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(1) Defined according to the classification of wetland types set forth in U.S. Fish and Wildlife Circular 39.

4.047 The drainage characteristics of a small area of wetlands upstream of the basin and downstream of the headwaters diversions would be altered. Initially these wetlands would lose a source of water and would tend to become drier. As the tailings pond reached maximum limits during the later stages of the project, there may be a ponding effect that would tend to hold water in these wetlands.

4.048 The loss of wetlands would remove another 800 acres from the nation's wetlands inventory. On the regional scale, cummulative impacts would not be as significant, as these wetlands types are common to the region.

4.049 Following the end of operations, a series of small ponds may dot the basin. These ponds, depending upon their eventual depth, would either become wetlands or ponds with wetland around their perimeter. As final designs for the basin following the end of tailings deposition have not been made, it is impossible to determine what the acreage of these ponds and/or wetlands may eventually be.

Threatened or Endangered Species

4.050 The proposed project would remove approximately 5,000 acres of habitat that could be used by the eastern timber wolf. Timber wolf populations appear to be on the increase in northern Minnesota and there have been requests from residents in northern Minnesota to have the species removed from the endangered species lists. It is unlikely that use of the Mile Post 7 site would significantly affect the eastern timber wolf population in northern Minnesota.

Water Quality and Aquatic Habitat

Lake Superior

4.051 The most obvious impact associated with the proposal would be the cessation of the discharge of taconite tailings into Lake Superior. The fibers found in the discharge have been declared a "potential health hazard" by the Eighth Circuit U.S. Court of Appeals. See paragraphs 4.101-4.102 page 74 for the public health impacts associated with the cessation of the discharge.

4.052 There still would be some release of tailings and fibers associated with erosion of the delta. (See paragraphs 4.025-4.033 pages 56-58 and paragraphs 6.024-6.028 pages 88-89.) It is unknown how long the fibers would remain suspended in Lake Superior once the discharge is stopped. There is a tremendous amount of tailings already present in the lake (64,400 tons are discharged daily).

Beaver River Watershed

Construction Phase

4.053 The construction phase would be the period of highest potential impact upon area streams. Construction of road and rail crossings of streams and of diversions would be direct physical alterations.

4.054 Impacts associated with these alterations would include loss of aquatic habitat, covering of benthic organisms, turbidity and siltation. The primary concern is with construction-induced turbidity and siltation. Turbidity causes a reduction in light transmission which in turn causes a reduction in photosynthesis with a subsequent loss in the stream's food production.

4.055 Siltation, if severe, can cover spawning beds and benthic communities, destroying them via suffocation. Construction activities in the streams may temporarily restrict fish movements but would have no lasting effects.

4.056 Each of these individual construction activities would have minor impact; however, cumulatively they could have substantial impact. Employment of proper construction techniques would reduce the overall potential for adverse impact on area streams from construction of stream crossings and diversions. See paragraph 4.072 page 65 for a list of conditions that would be placed upon a Corps permit, if issued, to reduce the impacts of construction.

4.057 Construction of the seepage recovery facilities would expose a large area of soil to erosion. Heavy rains before the sites could be revegetated would result in siltation of area streams, with the impacts described in the paragraphs above.

4.058 The impacts from construction of the main dams would be minimal as the seepage recovery dams would be completed and would have ponding areas behind them to catch runoff from the dam construction areas. These would act as settling ponds to reduce the potential for siltation of downstream waters.

Operations Phase

4.059 Diversions #1 and #2 (exhibit 25) would isolate about 9.7 miles of Big Thirty-Nine and Little Thirty-Nine Creeks, which lie in the proposed tailings basin. These isolated portions of the streams would eventually be covered and destroyed by the tailings pond. All aquatic organisms present (plankton, nekton, benthos, fish, aquatic plants, periphyton, etc.) would be lost. Loss of the streams would have an adverse effect upon the diversity of aquatic organisms in the watershed.

4.060 The diversions themselves would provide little in the way of aquatic habitat if constructed in the traditional straight-channel method with no bank cover. While the diversions would not approach natural streams as habitat for a considerable number of years (25-30), proper design could speed up the initial natural recovery processes.

4.061 The waters passing through the diversions would be warmed, which could have an adverse impact upon downstream organisms in late summer low-flow periods.

4.062 The diversion of Big Thirty-Nine and Little Thirty-Nine Creeks would increase flows in that portion of the Beaver River (2.5 miles) from the diversions down to the present mouth of Big Thirty-Nine Creek. These higher flows in the Beaver River would probably have beneficial effects upon aquatic biota. During spring flooding there would be erosion of the banks in this portion of the river, until the channel reworked itself to handle these increased flood flows.

4.063 The Beaver River downstream of the tailings basin would lose about 7 percent of its watershed. Uncollected seepage (estimated at about 180 gpm) from the basin is expected to mitigate some of this hydrologic loss. No change in January or February low-flows is anticipated. The overall effect of the reduction in drainage-basin size would be minor.

4.064 During the operations phase one source of impact would be uncollected seepage. Uncollected seepage would have the beneficial impact of providing additional flow during low-flow periods but could have an adverse impact if the seepage contained fibers.

4.065 Tests conducted by Reserve have shown that the fine soils beneath the tailings basin have the ability to filter most of the tailings and associated fibers from seepage water. This indicates that the potential for ground water contamination is low. However, monitoring of the ground water in the area would be conducted to detect any potential contamination.

4.066 Uncollected seepage would be approximately 180 gpm. It is estimated that a maximum of 600 lbs./day of dissolved solids would be lost. The maximum increase in total dissolved solids (TDS) in the Beaver River even during low flow periods (February) would be 4.7 mg/liter. (TDS for the Beaver River ranges from 70 to 120 mg/liter over the course of the year.) Thus, the seepage of dissolved solids should have no adverse impact on the Beaver River.

4.067 Reserve has set up surface water and ground water monitoring programs to monitor the effects of operation of the basin. (See exhibits 46 and 47.) In addition to the parameters listed in the exhibits, Reserve would also be monitoring for fibers. Reserve also has set up a stream biota monitoring program (exhibit 48).

4.068 If surface monitoring reveals water quality changes, it would be relatively easy to track down the source of contamination and take steps to correct the situation. However, if ground water monitoring reveals contamination of the ground water (especially with fibers), it would be very difficult to remedy the situation. Wells could be sunk down-gradient to pump the contaminated ground water back into the basin, but this would be a costly and possibly perpetual problem.

4.069 Listed below are the State water quality classification standards as they apply to the streams of the Beaver River watershed and Lake Superior.

DOMESTIC CONSUMPTION STANDARDS (WPC 14, WPC 15)

Substance or Characteristic	Limit or Range
Total coliform organisms	10 most probable number per 100 milliliters
Turbidity value	5
Color value	15
Threshold odor number	3
Methylene blue active substance (MBAS)	0.5 milligram per liter
Arsenic (As)	0.01 milligram per liter
Chlorides (Cl)	250 milligrams per liter
Copper (Cu)	1 milligram per liter
Carbon Chloroform extract	0.2 milligram per liter
Cyanides (CN)	0.01 milligram per liter
Fluorides (F)	1.5 milligrams per liter
Iron (Fe)	0.3 milligram per liter
Manganese (Mn)	0.05 milligram per liter
Nitrates (NO_3)	45 milligrams per liter
Phenol	0.001 milligram per liter
Sulfates (SO_4)	250 milligrams per liter
Total dissolved solids	500 milligrams per liter
Zinc (Zn)	5 milligrams per liter
Barium (Ba)	1 milligram per liter
Cadmium (Cd)	0.01 milligram per liter
Chromium (Hexavalent, Cr)	0.05 milligram per liter
Lead (Pb)	0.05 milligram per liter
Selenium (Se)	0.01 milligram per liter
Silver (Ag)	0.05 milligram per liter
Radioactive material	Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by the appropriate authority having control over their use.

FISHERIES AND RECREATION STANDARDS (WPC 14, WPC 15)

Substance or Characteristic	Limit or Range
Dissolved oxygen	Not less than 7 milligrams per liter from October 1st and continuing through May 31st, and Not less than 6 milligrams per liter at other times
Temperature	No material increase
Ammonia (N)	0.2 milligram per liter
Chlorides (Cl)	50 milligrams per liter
Chromium (Cr)	0.02 milligram per liter
Copper (Cu)	0.01 milligram per liter or not greater than 1/10 the 96 hour TLM value.
Cyanides (CN)	0.02 milligram per liter
Oil	0.5 milligram per liter
pH value	6.5 - 8.5
Phenols	0.01 milligram per liter and none that could impart odor or taste to fish flesh or other fresh-water edible products such as crayfish, clams, prawns and like creatures. Where it seems probable that a discharge may result in tainting of edible aquatic products, bio-assays and taste panels will be required to determine whether tainting is likely or present.
Turbidity value	10
Color value	30
Fecal coliform organisms	200 most probable number per 100 milliliters as a monthly geometric mean based on not less than 5 samples per month, nor exceed 400 most probable number per 100 milliliters in more than 10% of all samples during any month.
Radioactive materials	Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by the appropriate authority having control over their use.

4.070 The natural color value for the Beaver River ranges from 30 to 70 which exceeds the above standards as do the natural iron concentrations and turbidity values. The proposed project would increase turbidity levels during the construction of stream crossings and diversions that would further exceed the above standards.

4.071 In summary, there would be considerable potential during the construction period for siltation of area streams, primarily the Beaver River. The Beaver River and its tributaries are high-gradient streams which experience high spring flows. This characteristic would tend to flush excess silt from the river, relocating the remaining silt in the quiet-water areas where it naturally collects. No long-term impact upon fisheries of the area streams, save for the 9.7 miles covered by the tailings, is anticipated. Benthic communities disturbed by construction activities would restabilize themselves with no long-term effects on community structure or function.

4.072 The following mitigative measures would be made conditions of a Department of the Army permit, if issued, to reduce the potential impacts upon water quality and aquatic habitat:

(1) Stream crossings would be constructed during low-flow periods. Exposed areas around the culverts would be riprapped.

(2) Stream diversions would be constructed in one season following spring runoff. Dikes and banks would be stabilized.

(3) Permanent stream diversion would be constructed with the same sinuousity as the natural streams they replace.

(4) Instream devices would be placed in the permanent diversions to provide cover for aquatic organisms.

(5) Seepage collection dams and basins would be constructed before the main dams are constructed.

(6) Additional ground water monitoring wells would be required in a concentric pattern around those now proposed (exhibit 47).

Pipeline and Dam Safety

4.073 A number of safety factors have been incorporated in the pipeline design. They are:

(1) Stream crossings of the pipelines would be on launder bridges with catchment basins to hold the entire contents of the pipeline. Another catchment basin would be located at pumphouse No. 2. This basin would be large enough to hold 10 times the capacity of pipeline that would drain there (i.e., the portion of pipeline from pumphouse No. 2 to the basin). The pipeline from pumphouse No. 1 to pumphouse No. 2 would drain back into the clarifiers at the plant.

(2) The proposed design involves a ditch between the pipelines and the road. Any spills would collect here and drain to catchment basins at various pumphouses and be recycled to the system.

(3) The pipeline would be monitored electronically to detect leaks. If a leak occurred, the tailings would be routed to the second pipeline at the concentrating plant.

(4) Reserve has developed a plan for monitoring pipeline wear to insure that pipeline sections are replaced before they reach a stage where leakage or breakage could occur. A copy is on file with the St. Paul District Corps of Engineers and is available upon request.

(5) The pipeline system would be continuously monitored by roving patrols on the private pipeline access road. The maximum detection time (by personnel) for slow leaks (undetected by instruments) would be under two hours.

4.074 Pipeline failures fall into two classes:

a) A slow leak just below the level of detection of instruments.

b) A massive rupture which would be detected by the instrumentation which would shut down the pumps.

Kaiser Engineers determined that:

a) Maximum undetected leakage would be under 30 gpm.

b) A massive rupture would be stopped sufficiently fast that the maximum spill would be 1,000 gallons or less.

The impact of undetected leakage would be negligible. This material would enter the drainage ditches and be routed to the catchment basins. Likewise, a large break could also be contained with minimal impact.

4.075 Dam failure has been a controversial issue. Experts testifying at the State of Minnesota permit hearings believe that if the dams were constructed properly, the chances of dam failure would be very remote. The Corps of Engineers recognizes that consultants hired by the State of Minnesota and Reserve to investigate the dam safety question are eminently qualified, and their opinion that the dams would be safe carries considerable weight. The St. Paul District Engineer has indicated that the Corps would carry out further dam safety studies if requested to do so by the Governor of Minnesota. The Corps believes that the dams, as designed, would be safe.

Noise Levels

4.076 Almost all the noise from site construction would be attributable to the major pieces of equipment used in the construction area. The construction process would involve different phases of activity each of which would have its own mix of equipment and usage pattern, and consequently, its own noise characteristics. The location of activity would also vary for these phases (both on-site and off-site).

4.077 The construction noise level beyond the clearing limits would be attenuated by distance as well as by topography and vegetation. The degree of attenuation would vary depending upon the characteristics of the "line of sight" between observer and noise source. The attenuation rate for the Mile Post 7 site is assumed to be 5dB(A)/100 feet.

4.078 Increases in noise levels during the operation phase would be attributable to the tailings disposal operation. The combined noise effects of the disposal operation would depend upon the relative frequency and duration of activities associated with the operations. The actual noise levels would be sporadic due to the intermittent operation of much of the equipment.

4.079 For any area beyond the site clearing limits, the corresponding noise levels would depend upon the height of the dam. (During the life of the project, dam heights would be increased as the need arises.) The higher the dam, the less effective the surrounding terrain and vegetation would be in reducing the noise from the hauling, grading and compaction operations connected with the ongoing dam construction or coarse tailings disposal.

4.080 The effect of increased noise levels also depends upon the magnitude of the increase above the ambient conditions. While minor changes to the surrounding noise environment may go unnoticed (until they interfere with an activity represented by the standards) a radical change may elicit a response of annoyance. This is due to an individual's natural aversion to a significantly different noise environment than one to which he or she has become accustomed or has come to expect. This factor would include the desire to maintain (through non-degradation) the existing areas of solitude. For noise analysis, it was assumed that any increase of noise levels above the ambient conditions of between 6 dB(A) and 15 dB(A) would represent a minor impact, and any increase greater than 15 dB(A) would represent a major impact.

4.081 During the construction phase, 410 acres would be subject to major impact and 220 acres would be subject to minor impact. During operations, 2,400 acres would be subject to major impact and 950 acres would be subject to minor impact. No residences are in the area of impact.

4.082 At present the areas surrounding the site are little used, even for recreational purposes. Activities such as snowmobiling would create higher noise levels in the vicinity of the user than the site operations (although the areas impacted are substantially less) and thus the site noise would often not be perceptible above the recreational activity noise. Also, much of the noise-impacted land would be site buffer land and would not be opened to public use.

4.083 The noise from site operations would represent a permanent condition as long as the site was being used for tailings disposal. After 40 years, the noise levels would subside to the ambient conditions.

Air Quality

4.084 Air pollutant emissions would be generated by a wide variety of sources during both the implementation and operation of on-land tailings disposal. Particulate emissions from unconfined (fugitive) sources would substantially exceed total particulate emissions from other sources.

4.085 In general, fugitive emissions of particulate matter would occur whenever dry earth or tailings are exposed to the atmosphere and acted upon by wind or mechanical forces. During site preparation and construction, the major sources of fugitive dust would be (1) wind erosion of cleared land, (2) transfer and transport of earth during construction of access roads, dams and plant facilities, and (3) vehicular traffic on temporary unpaved roads. The major sources of fugitive dust associated with the operation phase would be wind erosion of exposed tailings, vehicular traffic on unpaved roads, and the coarse tailings transfer operation.

4.086 Reserve has substantially altered their project to reduce the areas of exposed tailings, to reduce in turn the fugitive dust problem and the associated airborne fiber problem.

4.087 The Minnesota Pollution Control Agency has analyzed in detail the problem of fugitive emissions from the proposed tailings basin. The most recent estimate by the MPCA is that operation of the Mile Post 7 site would increase total suspended particulate levels in Silver Bay by .63 ug/m^3. The average annual TSP levels in Siver Bay are presently about 30 ug/m^3. A substantial reduction in this level is expected to occur with the installation of air quality control equipment on the processing plant. The TSP levels with the Mile Post 7 plan in operation would be far below the primary (75 ug/m^3) and secondary (60 ug/m^3) TSP standards. Table 8 contains the emission factors used by the MPCA in their analysis.

Table 8
Emission Rates For Mile Post 7
Operations, Year 0-40

Source Type	Source Extent	Emission Factor	Uncontrolled Emissions (lb/day)	Percent Mitigation	Controlled Emissions (lb/day)
Vehicular Travel					
Dikes and Dams					
Light Duty Vehicles	300-100 veh-mi/day	0.4 lb/veh-mi	120 - 40	50	60 - 20
Heavy Duty Vehicles	50 veh-mi/day	6 lb/veh-mi	300	50	150
Glacial Till					
Light Duty Vehicles	600-800 veh-mi/day	2 lb/veh-mi	1200 - 1600	50	600 - 800
Coarse Tailings Transfer	27,500 tons/day	.07 lb/ton	1925	50	963
Active Exposed Coarse Tailings in Dams and Dikes	225 acres[1]	0.25 tons/acre/year	349	50	175

Total Controlled Emissions: 1948 - 2108 lb/day

Percent of emissions from tailings sources = 62 - 69

1 Assumes average splitter dike width of 200 feet

4.088 The following is a description of how the uncontrolled emission factors were derived (source: MPCA).

Vehicular Traffic on Unpaved Surfaces:

Light Duty Vehicles on glacial till: 2 lb/veh-mi
Light Duty Vehicles on dams and dikes: 0.4 lb/veh-mi
Heavy Duty Vehicles on dams and dikes: 6 lb/veh-mi

(1) Factors derived from direct measurements of emissions from dirt and gravel roads.

(2) Average Speed = 20 MPH for light duty vehicles
= 10 MPH for heavy duty vehicles

(3) Silt Content = 30% for glacial till surfaces
= 6% for active tailings surfaces (Additional silt is generated by tailings movement and vehicular traffic).

(4) Weight multiplier for heavy duty vehicles = 6

(5) Factors have been adjusted to climate of northeastern Minnesota.

Coarse Tailings Transfer: 0.07 lb/ton

(1) General Expression: $e = Ak \frac{S}{M^2}$.

where
e = Emission factor (lb/ton of material transfered)
A = Activity factor
S = Silt content (percent)
M = Moisture content (percent)
k = Experimentally determined proportionality constant

(2) Data from direct measurements of emissions from transfer of crushed stone aggregate:

e = 0.11 lb/ton
S = 1.6 percent
M = 0.7 percent
A = 1, by definition

$k = 0.034 \approx 0.03$

(3) Emission factors for transfer operations (without mitigation):

(a) Side dumping from railcar

S = 4%
M = 4%
A = ½

e = 0.004 lb/ton

(b) Movement of tailings within period of 2-8 hours by front-end loader, bulldozer and grader. (Material partially drys and additional silt is generated by tailings movement and vehicular traffic).

$$S = 6\% \quad M = 2\% \quad A = 3/2 \qquad e = 0.068 \text{ lb/ton}$$

(c) Total factor without mitigation:

$$e = 0.004 + 0.068$$
$$0.072 \approx 0.07 \text{ lb/ton}$$

Wind Erosion from Exposed Tailings in Dams and Dikes: 0.25 tons/acre/year

(1) Factor derived from direct measurements of wind erosion of exposed fields of varying silt contents.

(2) Only active "untreated" tailings areas are being considered; 100% mitigation is assumed for "treated" areas.

(3) Silt content = 6% (Additional silt is formed by tailings abrasion resulting from tailings movement and vehicular traffic).

(4) Factor has been adjusted to climate of northeastern Minnesota.

4.089 The MPCA estimates that the Mile Post 7 plan would increase fiber levels in Silver Bay from 131,000 to 402,000 fibers/m^3 on the average over the 40-year life of the project. MPCA used five basic steps in making thier projection of fiber concentrations. The first step was to determine the approximate number of fibers in a microgram (one pound equals about 454,000,000 micrograms) of coarse tailings dust. MPCA found that this number is at least 318,000 fibers per microgram and may be as high as 975,000 per microgram. The lower figure is for those fibers positively identified as the type found in Reserve's discharges while the higher figure represents total fibers (i.e., those identified as Reserve's fibers plus those not positively identified as, but very similar in nature to, Reserve's fibers).

4.090 The second step was to determine the amount of fugitive dust to be generated by the operation of the basin. This was done as described above in making the projections for TSP.

4.091 The third step was to determine how much of this fugitive dust would originate from coarse tailings rather than native soils. It was found that approximately 65.5 percent of the fugitive dust would come from coarse tailings.

4.092 The fourth step was to determine the impact of this dust on population centers. A climatological dispersion model (CDM) was used. The results indicated that the Mile Post 7 site would contribute .63 ug/m^3 of TSP to the ambient air of Silver Bay, as stated in paragraph 4.088 above.

4.093 The final step was to use the findings of steps one through four to determine the effect of the Mile Post 7 site on Silver Bay airborne fiber levels. The calculations are as follows:

> 0.63 ug/m^3 particulates x 0.655 (percentage of dust originating from coarse tailings) x 318,000 (positive amphibole fibers per microgram of coarse tailings dust) = 131,000 positively identified amphibole fibers per cubic meter of air.

4.094 Using the figure of 975,000 total fibers per microgram of coarse tailings dust gives a result of 402,000 total fibers per cubic meter of air.

4.095 At the State permit hearings, both the State's expert and Reserve's expert testified that most of the fibers not positively identifiable as amphibole fibers are in fact amphibole fibers.

4.096 The TSP emissions resulting from the Mile Post 7 operation would have little impact as .63 ug/m^3 is a relatively small amount of particulate emissions. The large improvement in TSP levels expected from the air quality controls being installed on the processing plant is expected to take on far more significance than the TSP emissions from the disposal site.

4.097 Fiber emissions constitute a more serious problem. As safe standards for airborne fibers have not been developed, any source of airborne fibers must be closely examined.

4.098 The 8th Circuit Court of Appeals stated that the abatement of Reserve's air emissions should reduce the airborne fiber level in Silver Bay to a level "ordinarily found in the ambient air of a control city, such as St. Paul." (Reserve Mining Co. vs EPA, 514 F. 2d 492 at 539 (8th Cir. 1975).) Evidence presented at the State permit hearing showed the levels in St. Paul to be approximately 7,000 fibers/m^3. Even if the air emission control equipment being installed on the Silver Bay plant were 100-percent successful in eliminating the plant as a source of airborne fibers, the ambient fiber levels in Silver Bay with the Mile Post 7 site in use would not meet the criteria established by the Court.

4.099 Reserve has developed an air quality monitoring program (exhibit 49). In addition to the program outlined in exhibit 49, Reserve would be required to monitor for fibers. Reserve also proposes to establish a meterological station and air monitoring station at the disposal site.

4.100 Reserve proposes to adopt the following mitigative measures to reduce fugitive dust emissions:

(1) All tailings in the basin will be covered with water.

(2) Exposed tailings on dam faces will be revegetated as soon as possible.

(3) Native materials will be used for road construction.

(4) Unpaved road surfaces will be sprayed with water by tank truck.

(5) Dust retardants, calcium chloride, sulfite liquor, bituminous emulsions, etc., will be used as needed on unpaved roads.

(6) Areas being excavated for foundations will be kept moist for fugitive dust control by sprinkling with water.

(7) Rail haul rather than truck haul or coarse tailings will minimize road dust.

(8) The tailings delta will be vegetated.

(9) Modifications to and installation of emission control equipment at Silver Bay facilities.

These measures would be made conditions of a permit form the Corps of Engineers, if issued.

Public Health

Lake Superior Fiber Levels

4.101 The project would result in an end to the discharge of tailings and associated fibers into Lake Superior. The courts have ruled that the fibers in Lake Superior constitute a potential public health hazard. To date, no conclusive studies have been completed indicating the health effects of ingesting the fibers.

4.102 Filtered drinking water is available for those communities along the north shore who get their drinking water from Lake Superior and who are down-drift of Silver Bay (many north shore communities are constructing permanent filtration plants). This water still contains some fibers but at levels far below those found in the lake. The fate of the fibers in Lake Superior is unknown. How long they remain in suspension will determine how long the communities will have to continue to use filtered water.

Airborne Fibers

4.103 One of the primary concerns with the proposed project is the unknown impacts associated with inhalation of airborne fibers. The Eighth District Court of Appeals has ruled that airborne fibers constitute a potential public health hazard. Some research (at the Homestake Gold Mine in Lead, South Dakota) has been completed in this area. The results indicate that prolonged exposure to fibers quite similar to those found in the ore from the Peter Mitchell Mine increases the chance of those exposed to develop diseases such as lung cancer, pleural and peritoneal mesotheliomas, and bronchogenic carcinoma, among others.

4.104 At the present time there are not standards for exposure of the general population to fibers of the type found in Reserve' emissions. The standard set by the Occupational Safety and Health Act for workers is 2 fibers/cc (2,000,000/cubic meter) over the course of an 8-hour exposure. The public health impact of the project fiber emissions cannot be delineated. The proper course of action appears to be treating any exposure as a potential health hazard and reducing emission levels to as low as possible.

Vector-Borne Diseases

4.105 Another public health aspect that needs consideration is the potential for creating mosquito breeding places, as these insects are carriers of encephalitis. It is unlikely that the tailings pond itself would provide suitable habitat for mosquito larvae. However, any backwater areas of the pond that collect dead vegetation could provide breeding sites. A Corps permit, if issued, would be conditioned to require that the pond be kept as free as possible of mats of dead vegetation. In any event, it is highly unlikely that any mosquito production created by the project would equal that which probably occurs naturally on the site at the present time.

Energy

4.106 The production and consumption of energy is recognized as a critical concern on a national scale. The planning, construction, and operation of a tailings basin and process facilities would require large amounts of energy. In 1974 Reserve consumed approximately 19,118.07 X 10^9 BTU's of energy. Of this, 91.43 percent was consumed by the Lakeside Power Plant in the form of natural gas (80 percent) and coal (20 percent).

4.107 The projected energy requirement for production of materials for and construction of the Mile Post 7 site and new plant facilities is 3,075 X 10^9 BTU's. The annual energy required for operation of the facilities is presented in table 9 below.

TABLE 9

ANNUAL ENERGY REQUIREMENTS FOR RESERVE MINING TACONITE OPERATIONS USING PROPOSED MILE POST 7 PLAN

	Equivalent BTU's
Operation of Facilities	20,788 X 10^9
Transportation of Materials	843 X 10^9
Construction of New Facilities *	77 X 10^9
Total Energy Required	21,708 X 10^9
Total Energy Required per Long Ton of Pellets Produced	2,286,553

* Energy required for construction pro rated over 40-year life of project.

Recreational Opportunities

4.108 The existing recreational use of the project area would be curtailed. The effect of this would be minor because the site currently receives limited recreational use.

4.109 The proposed action would cause a disruption of the existing North Shore Trail, as about 3.9 miles are contained within the proposed project boundaries. While the action only affects 7 percent of the State designated trails in Lake County, an important link in the Duluth to Finland trail would be abandoned. This trail, while currently being used primarily for snowmobiling, is planned to be used for hiking and bicycling and to be extended to Grand Portage. If the proposed project is implemented, the trail would have to be rerouted at Reserve's expense.

4.110 Portions of Big and Little Thirty-Nine Creeks would be destroyed. These are designated trout streams (Minnesota Department of Natural Resources). Though they currently do not receive much fishing pressure, their loss would be the loss of a finite resource.

4.111 Approximately 5,000 acres of wildlife habitat would be lost and not available for hunting use. Following the end of operations, the area would be revegetated and would again be available for hunting use.

4.112 Wind-blown dust from the tailings area into neighboring recreational areas (such as the lower Beaver River, Lax Lake, Silver Bay golf course, or the proposed Tetagouche State Park) should not have an adverse impact on recreational activities. Attendance in 1974 at the Baptism River State Park (which will become part of the proposed (Tetagouche State Park) was about 18,000. While no attendance projections are available for the proposed Tetagouche State Park, it can be expected that the proposed park would have at least that many in attendance. The knowledge that they would be exposed to airborne fibers may keep some people from utilizing these areas.

Aesthetic Values

4.113 Development of the proposed Mile Post 7 site would result in visual impacts on Cedar Creek, the east branch of the Beaver River, Big and Little Thirty-Nine Creeks, Lake County Roads 3 and 4, Bear Lake, and the development on the north side of Lax Lake. Should Forest Route 11 be constructed as proposed, the proposed Mile Post 7 site would affect visual quality along this route. Construction of the tailings basin would eliminate the following natural features: portions of Big Thirty-Nine and Little Thirty-Nine Creeks, the waterfall on Big Thirty-Nine Creek, and the East Ridge topographic features.

4.114 A tailings disposal pipeline is part of the proposed Mile Post 7 plan. The pipeline would be a double pipeline extending from the concentrator at Silver Bay to the southeast portion of the proposed Mile Post 7 site. Parts of the pipeline would be visible and parts would be visually absorbed into the landscape via topographic changes and vegetative cover. A maintenance road is to parallel the pipeline. A proposed railroad spur is to be located directly south of Dam No. 1. It is likely that the character of the vegetation would visually absorb the spur near its immediate intersection with County Road 4. For both the railroad spur and the pipeline corridor, linear swaths of right-of-way would have to be cut. These would not harmonize with the surrounding natural landscape.

4.115 The question of aesthetic impact is highly subjective. The tailings basin and associated facilities would be built in an area that is undeveloped. To some individuals this would be interpreted as a gross intrusion, to others it would mean little or nothing, while other people may enjoy the spectacle of viewing a large operation such as the proposed project.

4.116 While some scenic features would be destroyed, no features of unique scenic quality would be lost.

Agriculture

4.117 No working farms would be lost by the proposed project. However, 795 acres of potential prime agricultural land (best suited for wood production) would be lost (exhibit 50).

Socioeconomics

Planning Phase

4.118 During the period of planning, which concludes with final design and award of a construction contract for implementation, there would be minimal, if any, impacts from a socioeconomic point of view. However, in this instance, there may be a secondary effect due to the fact that, prior to entering the final design stage, the existing litigation and administration proceedings would have been resolved. Once these have been resolved, the outlook of Silver Bay and Babbitt residents would undoubtedly stabilize as compared to the uncertainties which currently exist.

Construction Phase

4.119 Changes in Employment. Construction jobs for revision of the concentrator plant and the construction of the Mile Post 7 tailings basin are estimated to reach a maximum of 500 to 1,000 at some point in the 3-year construction period. The majority of the labor force would be drawn from Duluth and the Iron Range, if the skills are available. The present taconite expansion construction force of 3,000 on the Iron Range will be decreasing through 1976, thus providing the most likely labor pool. The Silver Bay area would provide very few of the construction workers from the present labor force, which is virtually fully employed. It is reasonable to expect that some of the work force would come from areas outside the region. Workers would probably commute either on a daily or weekly basis, or would find temporary housing in the area. Indirect employment resulting from construction is expected to be minimal. However, the number of service employees would rise in proportion to the number of construction workers that settle in the area on a permanent or semi-permanent basis. Very little secondary employment would be generated by this construction work. Widespread supplier locations, commuting by many of the workers and the short-term nature of construction impacts would minimize the non-direct employment.

4.120 Housing and Public Services. It is not anticipated that a significant increase in permanent housing would take place in the Silver Bay vicinity during the construction phase because:

1. The implementation or construction phase for the Mile Post 7 proposal would last for only 3 years.

2. A substantial labor supply exists in the Duluth and Iron Range areas, which are within commuting distances.

3. Economic factors are not favorable for new home construction at this time.

Mobile homes could be utilized and private resorts in the Silver Bay area could possibly provide living accommodations. It is impossible to determine how many workers would or could take advantage of such facilities, but the number is felt to be insignificant. Rather, the great majority of construction workers would probably choose to commute from Duluth and the Iron Range, either of which is not an uncommon commuting distance for this part of the State. Since no significant increase in housing is expected in the Silver Bay vicinity, none is expected in the education or health care sectors. Impacts on electrical power, sewer and water systems during the construction phase are expected to be negligible.

4.121 Changes in Population. Population relocation impacts during the construction phase would depend primarily upon personal decisions of the construction labor force. However, previous employment assumptions, coupled with a lack of permanent housing, are expected to hinder significant permanent population growth in the Silver Bay area.

4.122 Tax Impacts. Generally, little or no change in tax base or tax receipts is expected to occur during the construction period.

Operation Phase

4.123 Changes in Employment and Economic Base. With the proposed Mile Post 7 plan, employment would increase slightly, presumably for operating and maintaining the tailings basin. However, there would be a reduction in manpower needed to operate the modified concentrator; thus a net labor force reduction in the Silver Bay area may result. However, the potential change in employment of plus or minus 1 or 2 percent of Reserve's labor force is comparable to typical monthly turnover.

4.124 Purchasing patterns of local residents are such that virtually total reliance is placed on Duluth for all major purchases. The local Sivler Bay market may draw new investment capital to provide commercial and professional services on the basis of a predictable future for Silver Bay.

4.125 Education. No significant change is anticipated in school enrollment from the change in employment levels.

4.126 Health Services. No significant change in health care is anticipated.

4.127 Housing. No significant impacts are anticipated during the operation phase of the Mile Post 7 proposal with respect to housing.

4.128 Change in Taxes. The reduced quantity of pellets to be shipped under the proposed action would reduce the State and local taxes payable by Reserve by an estimated $2.7 million per year, or about 18 percent of their 1975 taxes payable. Estimated total taxes payable by Reserve on the 40-year project life vary from $537 million to $559 million. Estimated Federal taxes, payable by the parent companies over the 40-year life, range from $678 million to $770 million. The range in taxes payable results from the proportion of debt financing used for the project.

Post Operation

4.129 Given the lack of insight inherent in long-range forecasting, reliable projections are impossible, of impacts due to Reserve Mining Company's cessation of taconite operations when operations at the present mine are complete. Undoubtedly, there would be an elimination of jobs. Based on the current Reserve employment level, it would appear that this could affect approximately 3,000 employees. Under the proposed Mile Post 7 plan, approximately 1,600 employees would be working at the mine pit, with 1,400 employees located at the Silver Bay operations. Based on present evidence, the mining industry would remain in the same locale. Consequently, those employees located near the Babbitt operations would have a better potential for reemployment in the mining industry than those at Silver Bay, without incurring relocation costs.

4.130 Major financial impacts would occur to St. Louis and Lake Counties due to the loss of all taxes attributable to Reserve Mining Company. This would include all taconite-oriented taxes paid by Reserve as well as State income taxes and sales tax from Reserve employees. Reserve Mining Company's State and local taxes are estimated to amount to $15.3 million in 1975.

4.131 Based on 1974 data, loss of all taconite revenues would mean a reduction by over 60 percent of the total revenue of the city of Silver Bay and 57 percent of the total revenue for the city of Babbitt. The impacts would extend throughout Lake County, parts of St. Louis County and the State of Minnesota. In the short run, eventual shutdown would generate an increased local demand on State welfare and social services, accompanied by a reduction in the total funds available for supporting these services.

Land Use

4.132 Development of the tailings basin would eliminate all of the existing uses and activities identified at the site. During the period of operation, the tailings basin would only be utilized as an industrial site. Following operation, its re-use potential would be somewhat limited. No revegetation or topographic relief of any significance would occur on the site without specific human actions.

4.133 The area immediately surrounding the tailings basin would be controlled for industrial use. This area would contain roads, railroads, pipelines and utilities, and supporting structures necessary for utiliziation of the tailings basin. Industrialization of public land removes its existing and potential capacity for public purposes. The Mile Post 7 site is located adjacent to the Superior National Forest. Approximately 50 percent of the proposed Mile Post 7 site is publicly owned.

4.134 The land adjacent to the tailings basin and associated project area would witness change as a result of industrial activities. The most significant impact is the limitation of recreational activities with which the industrial use would conflict. Urbanization developments other than those presently existing are not contemplated in these adjacent areas. However, new uses would be introduced into this area for the support facilities such as access roads, pipeline corridors, railroad tracks and spurs, utility corridors, construction facilities, potential construction housing and other associated uses. The land value, aesthetic appeal, and recreation potential of these adjacent areas would be significantly compromised during operations and potentially for an extended period of time following operations, depending on the nature and type of reclamation activities.

4.135 The propos ' action would intrude on the natural setting of a privately owned lake and residence abutting the project site. Construction of the on-land d'-posal facility would eliminate the potential for future recreational development and enjoyment associated with the high-use north shore recreational corridor.

HISTORICAL/ARCHAEOLOGICAL VALUES

4.136 In compliance with Section 106 of the Historic Preservation Act of 1966, Executive Order 11593 for the Protection and Enhancement of the Cultural Environment, and the Advisory Council on Historic Preservation's "Procedures for the Protection of Historic and Cultural Properties" (36 CFR Part 800), we have consulted the National Register of Historic Places as of 23 March 1977. No properties currently listed on or eligible for inclusion in the Register are located in the project area. However, as stated in paragraph 2.087 the archaeological and other historical resources of the area are largely unknown.

4.137 On the basis of a review of the sparse historical materials existing, three historic features have been identified within the proposed tailings basin. They are portions of the Greenwood Trail (an early overland route connecting the shore of Lake Superior with a fur-collecting station inland on Greenwood Lake), an old logging railroad grade, and the Swanstrom farmstead. The historic significance of these features remains to be determined by on-site surveys by professional archaeologists.

4.138 The State Historic Preservation Officer has recommended that actual on-site surveys for presently unknown prehistoric and historic archaeological sites be carried out prior to approval of the permit application. The applicant has been notified that such a survey will be required of any tailings disposal site which is selected for development (exhibit 51). When such a survey is completed, the Corps will review the information and obtain the comments and recommendations of the State Historic Preservation Officer.

5.000 PROBABLE UNAVOIDABLE ADVERSE IMPACTS OF THE PROPOSED ACTION

POWER PLANT DISCHARGE SYSTEM

5.001 The disturbance and noise associated with the construction phase of the project could not be totally avoided.

5.002 There would be some temporary turbidity associated with the dredging from the berm site and the construction of the berm.

5.003 The power plant would continue to consume non-renewable hydrocarbon fuel. The power plant would continue to dispense air emissions, even though these emissions would be required to be within State and Federal standards.

5.004 The power plant would continue to use approximately 106,000 gpm of water for cooling purposes. An unknown number of planktonic organisms would continue to pass through the plant with the cooling water and be subjected to thermal and mechanical stress.

5.005 Some fish would continue to be impinged on the intake screen. As Reserve could be required to conduct a 316(b) demonstration, their present method of operations could be changed in the future if it were found to be significantly affecting the biological system of the lake.

DELTA STABILIZATION

5.006 Hydrocarbon fuels would be consumed in the transport of the mine rock to the dike construction site.

5.007 Part of the tailings delta would be allowed to erode away into Lake Superior, thereby releasing an unknown quantity of fibers into the lake.

ON-LAND TAILINGS DISPOSAL

5.008 The soils on the Mile Post 7 site would be covered by tailings and their productivity destroyed. The tailings in the post-operation period would never be capable of replacing this productivity.

5.009 During the construction of the disposal site features and the road, rail, and pipeline crossings of area streams, there would be an unknown quantity of soil materials added to the streams of the area. This would cause some temporary turbidity and silt deposition that could destroy trout spawning areas and benthic populations.

5.010 During operations there would be the ever-present risk of pipeline failure that could allow tailings to enter the east branch of the Beaver River or White Rock Creek. An accident of this nature, although highly unlikely, would harm the aquatic ecosystems of the affected portions of the streams.

AD-A121 454 POWER PLANT DISCHARGE STRUCTURE DELTA STABILIZATION DIKE AND ON-LAND TACO..(U) CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT MAR 77 2/4

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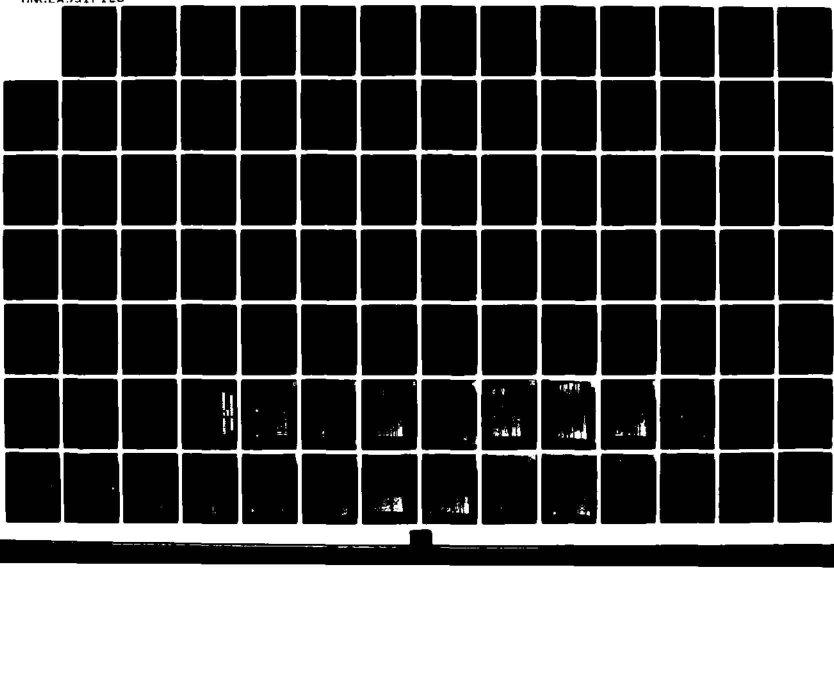

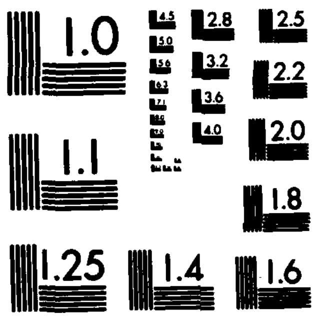

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

5.011 The proposed project would eliminate about 10 miles of natural stream which would be replaced by 1.5 miles of diversion channels. The diversion channels would not have the diversity of habitat necessary for a productive stream. They would be of little biological value for a number of years until the forces of nature formed meanders and a natural ripple-pool sequence.

5.012 All of the vegetation on the Mile Post 7 site would eventually be destroyed. Also, some of the ancillary facilities such as the pipeline and access roads would necessitate additional vegetation removal. The basin would not be revegetated for at least 40 years and it may take longer, considering the sterile nature of the tailings.

5.013 The Mile Post 7 site would be taken out of tree production for the next 40 years. It would take another 50 to 60 years after that to produce marketable trees on the site.

5.014 Approximately 5,000 acres of wildlife habitat would be destroyed. The wildlife not killed by being covered with tailings would suffer severe losses due to predation, starvation, stress and winterkill as they attempt to move into adjacent habitat that would already be at or near carrying capacity.

5.015 Implementation of the proposed plan would destroy habitat used intermittently by the eastern timber wolf, a species on the Federal Endangered Species List.

5.016 Implementation of the project would have an adverse impact upon the financial resources of Reserve's parent companies, Armco Steel Corporation and Republic Steel Corporation. This would tend to diminish the return on investment for the stockholders in these corporations. It would also keep these corporations from investing this money in other areas.

5.017 The recreational value of the Mile Post 7 site would be lost. There potentially would be a decrease in the quality of the recreational experience for some users of nearby parks and recreation areas.

5.018 The site would be tied up in industrial land use for 40 years. In the immediate post-operation years, the site would be of little use other than as an experimental revegetation site.

5.019 Noise levels in the area of the disposal site would be increased during both the construction and the operations phases. This increase should not affect presently settled areas.

5.020 There would be air emissions from the site primarily in the form of wind-blown dust. This would increase the total suspended particle (TSP) level in nearby communities, especially Beaver Bay and Silver Bay. More importantly there would be an increase in airborne fiber levels,

again primarily in Beaver Bay and Silver Bay. These fibers have been declared a health risk by the Eighth Circuit U.S. Court of Appeals.

5.021 Construction of the project would consume about 3,075 X 10^9 BTU's of energy. Annual usage by the Reserve operations after implementation would be approximately 21,691 X 10^9 BTU's of energy.

6.000 ALTERNATIVES TO THE PROPOSED ACTIONS

COOLING WATER DISCHARGE SYSTEM

Cooling Tower

6.001 An alternative to the proposed once-through cooling water system would be a closed cooling water system. This system would utilize a cooling tower.

6.002 Reserve contracted with Sargent and Lundy Engineers of Chicago to study the feasibility, costs, and effects of utilizing a cooling tower at the Lakeside Power Plant designed to cool 111,000 gallons per minute by 12 degrees Fahrenheit. It was determined that a 6-cell mechanical draft cooling tower with a 12-degree Fahrenheit approach and a 12-degree Fahrenheit cooling range would be best suited to the Lakeside plant.

6.003 The optimum location for a cooling tower would be on the tailings delta. This would hinge upon the final determination as to whether the delta could be stabilized or not. Two other possible sites were investigated on the Lake Superior shoreline above and below the Reserve complex. A cooling tower to serve the Lakeside plant's needs would be 55 feet wide at the base, 70 feet wide at the top, and 54 feet in height.

6.004 One of the main concerns regarding a cooling tower in the Silver Bay climate is fogging and icing during the cooler months of the year (October to April). This impact relates primarily to human safety as the plume from a tower can cause icing on power lines, buildings, and highways. Fogging on a major highway such as Highway 61 through Silver Bay would be a traffic hazard.

6.005 The Sargent and Lundy study evaluated this problem and determined that the 2,900-foot distance from the optimum tower site on the delta to Highway 61 would be sufficient to minimize these impacts. There would probably be icing on the structures in the Reserve complex at times as they would be closer to the tower.

6.006 A minor impact associated with a cooling tower on the Lake Superior shoreline would be the aesthetic impact. The north shore of Lake Superior is under consideration both as a National Scenic Shoreline and a Minnesota Critical Area. A 54-foot high cooling tower is not the type of structure that would be considered compatible with a scenic area, although this impact would be lessened somewhat by the fact that such a tower would be located within a developed area at the Reserve complex at Silver Bay.

6.007 A desirable impact, as compared to the proposed plan, is that there would not be 106,019 gpm of Δ 12° F water being discharged into Lake Superior. This would eliminate the possible impacts associated

with this discharge as discussed in section 4.000. In addition, once the closed system was made up, there would be a large reduction in the amount of Lake Superior water taken into, and physically circulated within, the plant cooling system.

6.008 Reserve has estimated that a cooling tower would require a 3-percent blowdown to avoid an excessive buildup of chemicals used to prevent corrosion and to act as biocides. This would mean a discharge of approximately 3,000 gpm of blowdown water. Reserve is unsure at this time if adding this blowdown water to the proposed closed-circuit water for the taconite processing plant would interfere chemically with the proposed flotation or other plant processes. The taconite plant system would require 1,387 gpm of make-up water. Therefore the cooling tower alternative would result in the discharge of 1,613 gpm of blowdown water into Lake Superior (or 3,000 gpm if the water is not used in the taconite plant).

6.009 The blowdown water would be high in precipitable solids (Ca, Mg, Na, etc.) and would probably also contain chlorine as this is the common biocide used in power plant systems. In comparing the volume of blowdown water discharged to the volume of the receiving water (Lake Superior), it is anticipated that the impacts from this discharge would be minimal.

6.010 There would be few construction-associated impacts if the tower were built on the tailings delta, due to its barren nature. If a tower were constructed on another site, there would be a destruction of some terrestrial habitat at the tower site and along the route of any circulating water pipelines built from the power plant to the tower.

6.011 There would be an adverse economical impact on Reserve and its parent companies resulting from this alternative. The estimated cost of the proposed discharge pipe and diffuser is $850,000. The construction cost for a cooling tower, as estimated by Sargent and Lundy, would be $3,727,000 with annual operating, maintenance and power costs of $143,256. This would have additional impact as it would occur at a time when Reserve would be spending a large amount of capital on development of their on-land tailings disposal site.

6.012 There would be some additional employment of construction workers if a cooling tower were built. Reserve does not believe that additional personnel would be needed to operate a cooling tower system.

Alternative Location of the Proposed Discharge Structure

6.013 One possible alternative site for the discharge structure would be within the harbor at Silver Bay. Beneficial impacts associated with this site would include less initial costs for the discharge pipe and less visual impact upon Beaver Island.

6.014 An adverse impact would be the possibility of a temperature buildup within the harbor due to lack of circulation. This could adversely affect cold-water organisms within the harbor. In addition, the heat buildup could lead to the possible short-circuiting of heated water back into the power house, thereby reducing generating efficiency. Reserve did not select this alternative because of the possible heat buildup problem.

6.015 Another alternative location would be on the eastern side of the tailings delta. Discharge here would introduce the possibility of interaction of the heated water with the nutrient output of the Silver Bay Municipal Sewage Plant. Also, this alternative would require running the heated water discharge pipe across the tailings delta where it could interfere with possible future construction activities on the delta.

Alternative Discharge Procedure

6.016 An alternative to the proposed horizontal underwater discharge would be surface discharge. Reserve has calculated that, with a surface discharge, the 0.5° F isotherm would inclose about 220 acres as compared to about 5 acres with the proposed system Surface discharge could possibly stimulate an increase in plankton production near the point of discharge.

Alternative Intake Structure Location

6.017 Relocation of the intake structure so that cooler water could be taken in could result in a smaller ΔT (change in temperture) at the proposed discharge point during certain times of the year. At present the Lakeside Power Plant structure is located near the plant in the artificial harbor. The water taken in is warmer than that found at the proposed discharge point during late summer as it is surface water in an inclosed harbor.

6.018 The new intake structure would have to be located at a depth of about 30 meters to obtain significantly cooler water during the late summer months. During most of the year Lake Superior is nearly isothermal and, except during the summer, the present structure takes in water of about the same temperature as the rest of the lake.

6.019 The most logical area to attempt to place an intake structure at the 95-foot depth would appear to be south of Beaver Island in the area of the proposed discharge structure. In this area the 95-foot contour is approximately 450 feet out from the shore of Beaver Island. An intake structure here would require placement of an intake pipe of approximately 460 feet in length running out into Lake Superior from Beaver Island.

6.020 The beneficial impacts associated with this alternative would be a reduction in the ΔT at the discharge point during the warmer months of the year. This would reduce the probability of any impacts occurring on aquatic organisms as well as reducing the scope of such impacts. (See description of impacts of the proposed discharge structure, section 4.000.)

6.021 This alternative structure would put an added economic burden of unknown extent on Reserve and its parent companies at a time when they are investing large sums of capital into converting to an on-land tailings disposal site.

Alternative Dredging and Disposal

6.022 At present, Reserve proposes to dredge mechanically at the site of the proposed discharge and dispose of the materials in a diked area on the delta. An alternative would be to dredge hydraulically. This would reduce turbidity associated with the dredging operation and increase the volume of return water from the disposal site. At present it does not appear that increased turbidity associated with the mechanical dredging would have substantial enough impacts to warrant the use of a hydraulic dredge.

6.023 An alternate mode of disposal would be to deposit the material on the tailings delta and truck it to an on-land disposal site. The impacts of disposal at an on-land site would appear to be more adverse than disposal on the delta, with the added factor of increased costs.

DELTA STABILIZATION

6.024 The alternative to stabilizing the delta would be not to stabilize it. This would allow it to erode away under the force of Lake Superior waves and currents. At the present time it is not known what would be the ultimate configuration of the delta. Dr. Duncan Hay of Western Canada Hydraulic Laboratories Ltd., a recognized expert in this field, has theorized that the delta would assume the approximate shape shown in exhibit 52. This theory is based on the assumption that a permanent connection is maintained between the shore and Rock Island on the east side of the delta.

6.025 Reserve has calculated the amount of tailings and fibers that would erode with the non-stabilization alternative. This alternative would allow 13.3 million cubic yards of tailings to erode from the delta (19.684×10^6 long tons). This would be comparable to 305 days of present discharge.

6.026 Reserve has calculated that 2,205 tons of fibers would be released, equivalent to the amount released by 7.7 days of present operations.

6.027 If Reserve's calculations were in error, as discussed in paragraph 4.029 page 57 the worst-case situation would be the release of fibers equivalent to that released by 305 days of present discharge.

6.028 The impact of the release of fibers equivalent to 7.7 or 305 days of existing discharge cannot be assessed because it is not known how long the fibers remain suspended in Lake Superior nor how often they may be resuspended.

ON-LAND TAILINGS DISPOSAL

Background

6.029 Since the Eighth Circuit Court of Appeals upheld the District Court's decision that Reserve must end their discharge into Lake Superior, a number of on-land disposal sites have been considered. At one time or another, 16 different sites have been considered. Three sites (Bluebill Lake, Nip Creek, and Isabella River) were eliminated because of prohibitive costs associated with use of those sites. Two sites (Palisades and Lax Lake) were discarded because the Minnesota Department of Natural Resources (DNR) concluded that if only North Shore sites were compared, Mile Post 7 had the least environmental impact of the three. Six other sites (Sawmill Creek, Split Rock River, Gooseberry River, Kit Creek, Taimi Creek, and Ridgepole Creek) were eliminated because they did not have the capacity to store 40 years' worth of tailings.

6.030 By mid-1975, the State of Minnesota had the list narrowed down to six potential sites: Mile Post 7 (Reserve's preferred site), Midway, Colvin, Snowshoe, Embarrass, and the Mine Pit.

Mine Pit Disposal

6.031 One tailings disposal site which had been considered was Peter Mitchell Mine pit at Babbitt, Minnesota. Utilizing the mine pit would require Reserve to construct new processing facilities at the mine pit site in Babbitt to produce iron concentrate. The concentrate would be transported to Silver Bay in insultated rail cars where it would be pelletized and shipped. The present concentrating facility at Silver Bay would be dismantled.

6.032 The primary beneficial impact of disposing in the mine pit as compared to other on-land sites would be the minimal destruction or alteration of large areas of undeveloped lands. There would be less chance of further destruction due to accidental release of tailings into the environment either through pipeline failure or as windblown dust.

6.033 The primary adverse impact would be the alteration of the living patterns of the 450 to 480 Reserve employees in the concentrator facilities at Silver Bay. They would find their place of employment shifted to Babbitt and would be forced to adjust either by seeking new employment, moving to the Babbitt area, or commuting to their new jobs at Babbitt.

6.034 With this plan, Reserve would have to increase its financial investment in the switch to on-land disposal of tailings.

6.035 The State of Minnesota, recognizing the possibility of using the mine pit as a disposal site, had a study conducted to determine the feasibility of such an effort. The study was done by Professor Donald H. Yardley of the Department of Civil and Mechanical Engineering at the University of Minnesota. The report revealed that there is insufficient area available in the mine pit to dispose of the fine tailings without covering exposed commercial taconite; and the construction of the dams necessary to contain these tailings would require importation of approximately 66 million tons of material annually from elsewhere. (Not enough coarse taconite tailings are produced by Reserve to provide this volume.) It was concluded that disposal of tailings in the pit is not engineeringly feasible. Copies of the Yardley report are on file in the St. Paul District Office, Corps of Engineers, and it is also found in Appendix C of the State of Minnesota EIS (1975).

Current Status

6.036 The position of the DNR and the Minnesota Pollution Control Agency (MPCA) is that all five remaining alternative sites (Mile Post 7, Midway, Embarrass, Colvin, and Snowshoe) are technologically and economically viable alterantives. The DNR and the MPCA believe that Midway is the most environmentally acceptable site.

6.037 Reserve has taken the position that the Babbitt sites (Embarrass, Colvin, and Snowshoe) are technologically unsound and economically non-viable. Also, Reserve contends that it would be more prudent for Armco and Reserve to buy ore from foreign sources than to expend the money necessary to develop at the Midway site. Thus, the present position of Reserve is that they will close down operations if not allowed to use the Mile Post 7 site.

6.038 Based upon the information presently available, the Corps believes that the Babbitt sites can be viable technologically with the use of research and development programs to handle the problem of rail transport of wet concentrate in the winter and to properly design and construct the containment facilities.

6.039 It is clear that Reserve would incur a net reduction in profit or a loss in current operations whether the company moves to an on-land disposal site or terminates operations. Therefore, Reserve is seeking the least costly and still environmentally acceptable alternative, provided the capital costs of meeting environmental standards are not excessive. Reserve could still reach the conclusion that on-land disposal at any site does not warrant the investment and increased operating cost, and thus terminate operations.

6.040 Following review of all the economic data published by Reserve and the State of Minnesota, the only disposal sites that appear to warrant economic consideration at this time are Mile Post 7 and Midway. All the Babbitt sites have prohibitive costs unless there is a major change in the financial position of the parent companies or a willingness by the State of Minnesota to finance a portion of the cost.

6.041 Both Mile Post 7 and Midway, according to provided data, are economically feasible on the basis that they generate a positive cash flow and a moderate rate of return or investment. Mile Post 7 would have a greater cash flow than Midway.

6.042 The parent companies of Reserve Armco and Republic, will make the final decision on corporate economic feasibility. Feasibility will be based upon other investment opportunities, cost and availability of alternative sources of iron ore, the financial position of the companies, and the importance of control of a domestic pellet supply.

Babbitt Sites

6.043 Since July 1976 the Babbitt sites (exhibit 53) have fallen by the wayside in the site selection process on-going between the State of Minnesota and Reserve. Design concepts introduced in the State Public Hearings (covering all tailings with water) have made some of the designs for the Babbitt alternatives contained in the draft EIS obsolete and, since the State Public Hearings, no new designs have been developed.

6.044 The following is a discussion of the three Babbitt alternative sites based on the most recent information available. The reader should be aware that because of the position of the DNR, the MPCA and Reserve, the Babbitt sites have been relegated to a "secondary" alternative status and that the potential for one of these sites to be selected by both the State of Minnesota and Reserve appears remote. It is Corps of Engineers policy that no permit will be granted for an activity that has not received approval from the appropriate State agencies.

Embarrass Site

6.045 Facilities and Operation. The Embarrass tailings disposal area would be located adjacent to the present Peter Mitchell Mine, northwest of the western end of the mine pit. The utilization of the Embarrass site would require the construction of a railroad bed from the existing coarse crusher no. 2 to newly constructed rail car dumping, fine crushing, dry cobbing, concentrating, concentrate filtering, concentrate loading, and tailings disposal facilities. The concentrate filter cake would be transported in insulated rail cars to Silver Bay, where the cars would be unloaded and the concentrate fed to the existing pelletizing plant.

6.046 The new facilities at the Embarrass site (exhibit 54) would be constructed on the linear ridge trending northeast-southwest, which would form the southern boundary of the Embarrass tailings basin. In addition to the new rail car dumping, fine crushing, dry cobbing, concentrating, concentrate filtering, concentrate loading, and tailings disposal facilities, other facilities would be required for reagent storage, office and change rooms, heating, sewage treatment, electrical substation, etc. Exclusive of lands for rail car storage at the car dumper and turn around for the concentrate loadout, these new facilities would require approximately 130 acres. The coarse cobbed and sand-size filtered tailings would be transported to the 4,794-acre basin by truck and the fine tailings would be discharged directly to the basin. Water from the basin would be returned to the concentrator by a return water pipeline. The Embarrass on-land tailings disposal alternative would include tailings dams, tailings pond, seepage collection, and access road construction.

6.047 These new facilities would process 34.8 million long tons of crude taconite ore annually. The concentrate produced would have the same iron and silica content as the modified Silver Bay concentrator for the proposed Mile Post 7 plan. However, the new facility would have a production capability to match the existing Silver Bay pelletizing plant, resulting in pellet production of 10.2 million long tons per year rather than 9.5 million long tons per year with the proposed Mile Post 7 plan.

6.048 Rail Haulage of Coarse Crushed Ore. Coarse crushed taconite ore, of less than 4-inch size, would be loaded into 85-ton railroad cars at crushers nos. 1 and 2. These cars then would be assembled into unit trains that would carry the crushed taconite about 7 miles to the car dumper at the Embarrass site. This requires a new private railroad between the crusher no. 2 and the car dumper. The new road bed would be about 4 miles long with a double track, as shown in exhibit 55.

6.049 Fine Crushing. When the ore trains arrive at the new car dumper at the Embarrass site, the cars would be dumped by one of two rotary car dumpers in parallel, and the ore conveyed to bins. Apron feeders would withdraw the 4-inch and finer taconite ore and transfer the ore onto ten conveyors feeding ten paralleled crushing lines in the new fine crushing and dry cobbing building. In the third stage of crushing, the ore would be reduced (the initial two stages of crushing occur at the mine pit as explained for the existing operations) from 4 inches to approximately 1-¼ inches. Material discharged from the third stage crushers would pass over double deck screens. Screened material larger than 3/4 inch in size would be fed to the fourth stage crushers. Material smaller than 3/4 inch would bypass the fourth stage crushers, where it would rejoin the smaller than 3/4-inch product discharged from the fourth crushing stage. The 97-percent less than 3/4-inch size taconite ore then would be conveyed to distribution bins before the dry magnetic cobbers.

6.050 Dry Cobbing. The finely crushed taconite ore in the dry cobbing distribution bins would be fed to double drum, dry magnetic cobbers. The dry magnetic separation would reject approximately 20 percent (6,974,700 dry long tons per year) of the taconite ore as a coarse cobbed tailing. This coarse cobbed tailing would be conveyed from the new fine crushing and dry cobbing building and placed in loadout bins or stacked in a stockpile. The dry magnetically concentrated material would be conveyed from the fine crushing and dry cobbing building to storage bins in the concentrator building.

6.051 Concentrating. The partially concentrated taconite ore, 3/4-inch and finer in size, would be drawn out of the concentrator storage bins at a controlled rate and conveyed to 10 identical parallel concentrating circuits. The partially concentrated ore and water would be introduced to the system, and waste tailings and concentrate, both containing water, would be the outputs of the system. The process is one of repeated grinding, magnetic separation, hydraulic separation, flotation separation, sizing, and dewatering to reject a non-magnetic waste material as tailings.

6.052 The concentrating process for the new concentrator at the Embarrass site would be essentially the same as for the modified existing Silver Bay concentrator for the proposed Mile Post 7 plan. The process consists of one stage of rod mill grinding, two stages of ball mill grinding, four stages of magnetic separation, three stages of sizing including fine screening, two stages of flotation, and two stages of dewatering and hydraulic separation. Tailings would be discharged at seven points during the process, with all tailings discharges flowing to the tailings separation and filtering system.

6.053 The major difference between a new concentrator and the modified existing Silver Bay concentrator for the proposed Mile Post 7 plan is that the number of parallel concentrating circuits would be separated from the larger size tailings. The finer, silt-size tailings would be reduced from 22 to 10 circuits with the new concentrator. This reduction in concentrating circuits occurs because of the current availability of larger grinding mills with more than double the capacity of mills available when the Silver Bay facility was constructed in 1955.

6.054 Concentrate Filtering. Concentrate from the ten concentrating circuits would flow to two 75-foot hydroseparators outside the concentrator building. The overflow from the hydroseparators would be pumped to the tailings separation and filtering system. The underflow or concentrate from the hydroseparator would be pumped to the concentrate filtering building where the steam-heated concentrates would be dewatered to approximately 10 percent by vacuum filtering. The concentrate filter cake would be conveyed to the concentrate loadout bin over the railroad track.

6.055 Concentrate Loading. Concentrate filter cake would be loaded from the concentrate loadout bin over the railroad track into insulated railroad cars for haulage to Silver Bay.

6.056 Rail Haulage of Concentrate. Concentrate filter cake would be hauled approximatley 50 miles from the Embarrass site to Silver Bay on Reserve's private railroad in 85-ton railroad cars. To retard freezing of the wet concentrate filter cake while in transit in the winter months, insultated, open-top cars would be used. Each car would have a 2-inch layer of polyurethane foam insulation on exterior sides, ends and bottom. The interior of each car would have a polyurethane coating covered with one-half inch painted plywood. This technique is unproven and would require a research and development project to perfect.

6.057 Concentrate Unloading and Handling. When railroad cars loaded with concentrate filter cake would arrive at Silver Bay, the cars would be dumped by two new parallel rotary car dumpers. The concentrate would be conveyed from the dump hopper to three new concentrate surge bins. The concentrate would be dishcarged from the surge bins into the existing pelletizing plant feed system.

6.058 Tailings Separation and Filtering. Tailings from the concentrator would flow to the tailings separation and filtering system. This system would consist of five identical parallel circuits for tailings separation, with each parallel circuit processing the tailings from two of the ten parallel concentrating circuits. The tailings would first flow to a hydroseparator, where the finer silt-size tailings would be separated from the larger sand-size tailings. The finer silt-size tailings would flow to clarifiers, where they would be dewatered to a 50-percent-solids (by weight) slurry and then discharged by gravity flow into the tailings basin (14,410,300 dry long tons per year). Settling would be aided by a flocculent. The clarifier overflow water would be reclaimed and pumped to

the concentrator process water system. The larger sand-size tailings from the hydroseparators would be pumped to the tailings filtering building, where the tailings would be reduced to 10-percent moisture by cyclones and belt type filters. Water would be returned to the concentrator for recovery. The filtered tailings (2,393,700 dry long tons per year) would either be conveyed to a stacking conveyor and stockpiled, or conveyed to and mixed with the dry cobber tailings.

6.059 Dam Construction. The Embarrass tailings disposal area is located in the upper Embarrass River watershed, which is tributary to the St. Louis River Basin. Exhibit 54 shows the approximate basin. The tailings basin would be created by construction of a dam along the northern and westerly limits of the site, utilizing the prominent ridge running in northeast-southwest direction for its southern boundary. The basin has been divided into the East Embarrass and West Embarrass portions, referring to stages of development. The east site would be developed first, utilizing a starter dike; utilizing a tailings dam along the northerly limits, the basin would be raised to approximately elevation 1,570 feet. Following this, tailings disposal would be shifted to the west basin where a starter dike would be constructed using tailings, and the basin would be raised to the same height as the east basin. The south limit of the west basin was selected in anticipation of some expansion of the tailings basin for Erie Mining Company.

6.060 The separation of the Embarrass site into two basins would provide a better control over runoff tributary to the settling pond. Also, the amount of tributary drainage area removed from the Embarrass River at any one time would be reduced by this procedure. Following stabilization of the east basin, runoff and seepage could possibly be treated and released to the Embarrass River or diverted for make-up water to the east basin. During periods of heavy runoff, the relatively small surface area of the west basin would offer advantages in minimizing accumulation of excess runoff.

6.061 Tailings Disposal. It is assumed that tailings disposal at the Embarrass site would be similar to that proposed at the Mile Post 7 site.

6.062 Make-Up Water Pipeline. A buried 24-inch make-up water pipeline would be required from Birch Lake to the Embarrass basin. A 100-foot-wide right-of-way for the pipeline would also be required.

6.063 Seepage Collection System. A seepage collection system would be constructed on the outside of the basin to intercept seepage through the dams and runoff from the outside dam slopes. This system consists of an intercepting ditch and dikes to collect the combined seepage and runoff. There would be temporary storage ponds and pump stations for collection and return of the water to the basin.

Because the seepage collection system would generally be located from 500 to 1,000 feet outside of the top of the dam, an additional drainage area, located between the seepage collection ditches and top of the dam, would be added to the watershed tributary to the basin. Criteria for design of the collection system and return water pumping stations would be based on the estimated seepage rate plus pumping capacity and temporary storage to collect a 10-year frequency runoff event from the drainage area tributary to the collection system.

6.064 Access Roads. Access corridors from existing roads in the vicinity of the Embarrass site would be required. An existing road runs within one-half mile of the tailing basin limits. Access roads around the basin perimeter would also be required, as well as a pipeline maintenance road between the basin and the plant. It is likely that the cleared access width to the basin areas would be in the range of 100 to 200 feet with a road width of about 50 feet. Additional access corridors would be required for construction of the plant facilities. The Embarrass plant site would require an access road approximately 10.6 miles in length. Access routes would likely be limited in width to a cleared area of about 100 to 150 feet and a surface width of 40 feet.

6.065 Utilities. The new facilities at the Embarrass site would require the construction of a high-voltage electrical transmission line between Reserve's power generating plant at Silver Bay and the Embarrass site. The transmission line would be double-pole construction within the railroad right-of-way. A right-of-way of 100 feet would be required to accommodate this construction. Reserve's Silver Bay generating plant would possibly supply 75 MW. If Reserve's Silver Bay generating plant is not capable of supplying the total electrical power demands for facilities at the Embarrass site as well as concentrate unloading and handling, pelletizing, and dock facilities at Silver Bay, then Reserve would have to purchase additional power from Minnesota Power and Light. Modifications to Reserve's Silver Bay generating plant would be the same as described for Reserve's proposed Mile Post 7 plan.

6.066 Environmental Setting. The bedrock at the Embarrass site is primarily granite intrusives. The south ridge, which borders the tailings basin site, is the Giants Range Granite with flatter-lying granite in the valley floor.

6.067 The granite ridge formed by the Giants Range deflected the flow of several ice lobes through this area. This resulted in the deposition of granular soils, gravel, and bouldery and sandy till on the site. The rocks which underlie the Embarrass alternative site do not contain any known minerals of value.

6.068 The Embarrass tailings basin would lie in the Embarrass River watershed. The Embarrass River watershed shows extensive swamp and wetland lying along the Embarrass River, including a major portion of the area proposed for the west tailings basin. Considerable

storage capacity exists in the northerly portion of the watershed tributary to Bear Creek, which flows into the Embarrass River. The southern and eastern portions of the watershed are rather steep and rocky. However, runoff from this area flows into the extensive swampland along the Embarrass River. The stream network is not as complex as found in the Beaver watershed. The Embarrass River has a number of small tributaries from the south, originating in the steep slopes forming the southern watershed boundary. The northern portion of the watershed, which is generally flat and marshy, contributes runoff to the Embarrass River primarily through Bear Creek and Camp Eight Creek. Generally, the watershed is gently rolling to hilly land with extensive storage in the form of marshes. Wetlands appear to occupy from 30 to 40 percent of the total area.

6.069 The primary outlet for groundwater in the Embarrass site is the Embarrass River. The prominent ridge on the southern edge of the basin area has bedrock at or near the surface which results in groundwater at or near the surface. Steep bedrock gradients result in steep groundwater gradients. These steep gradients, in turn, result in the creation of bog areas at the base of the ridge due to groundwater flowing over the surface. The piezometric map at this site indicates that the general groundwater flow is from south to north toward the Embarrass River. The area is generally underlain by sands and gravels with relatively high permeabilities on the order of 10^{-3} to 10^{-2} centimeters per second (86 to 862 feet per month).

6.070 Portions of Spring Mine Creek (3.4 miles) and Ridge Creek (1.27 miles) lie within the potential tailings basin boundary. Both flow into the Embarrass River which flows parallel to and about 1 mile north of the northern boundary of the basin. Trimble Creek lies immediately east of the Embarrass basin site. These streams are warm water feeder streams that are clear and free of pollution. They are small and relatively unproductive in terms of fishing potential.

6.071 Mud Lake (7 acres) lies within the basin boundaries. Kaunonen Lake (13 acres) lies immediately outside of the northern boundary of the basin. Both these lakes support a warm water fishery.

6.072 The limited sampling data available on water quality and aquatic biota for the Embarrass site are on file at the St. Paul District Office, Corps of Engineers.

6.073 The forest vegetation on the Embarrass site is rather homogeneous and largely aspen-birch with aspen predominating. Some areas support either jack pine (<u>Pinus banksiana</u>) or black spruce (<u>Picea mariana</u>). It is estimated that about 12 percent of the site is covered by these species. The only timber type is the black ash which covers no more than 2 percent of the site.

6.074 About 8 percent of the east Embarrass basin area is wetland while 28 percent of the west Embarrass basin is wetland.

6.075 The Embarrass site provides habitat for the same regional fauna as discussed for the Mile Post 7 site. The site lies within the major range of the eastern timber wolf. The site is not as well suited for semiaquatic species such as the beaver (Castor canadensis) or for moose as the Mile Post 7 site. The Embarrass site provides better ruffed grouse habitat than the Mile Post 7 site while Mile Post 7 has better spruce grouse habitat. No detailed wildlife surveys have been conducted at the Embarrass site.

6.076 The Embarrass site lies about 6 miles southeast of Babbitt, Minnesota (1970 population 3,740). The small town of Embarrass is about 4 miles east of the basin site. Babbitt, like many of the towns on the Mesabi Iron Range, has a large number of its residents employed in the mining industry. Reserve employs 1,640 people at the Peter Mitchell Mine and the primary crushing facilities at Babbitt. Most of the employees live in Babbitt (42.9 percent), Ely (33.4 percent), or other areas on the Iron Range (20.2 percent). Ely (population 4,750) is about 14 miles northeast of Babbitt.

6.077 In 1974 Reserve paid $271,180 in taconite taxes to the city of Babbitt. An additional $649,728 was paid to School District No. 692 which is the district containing the Babbitt schools.

6.078 The residents of Babbitt have housing, educational facilities, health care, etc., on a level comparable to most communities on the Mesabi Iron Range.

6.079 Existing man-made facilities on the Embarrass site include 21 homes, farm structures, a power transmission line, an improved light duty road and two trails. About 85 percent of the site is in private ownership and the remaining 15 percent is publicly owned.

6.080 An Indian trail runs close to the southern boundary of the site, and the remains of an Indian camp are located at the southeast corner of the site. No other known cultural resources are located on or near the site.

6.081 The site has some recreational value, primarily for hunting and snowmobiling. There are few fishing opportunities available in the small streams on the site. There are no existing or proposed major recreation areas in the vicinity of the site.

6.082 Air quality in the area is relatively good. There has been no sampling for Total Suspended Particles (TSP) at Babbitt but the table below shows the results of sampling at Ely and Hoyt Lakes (17 miles southeast of Babbitt).

TABLE 10

MEASURED 24-HOUR CONCENTRATIONS OF TSP*

	Annual Geometric Mean (μg/m^3)					Maximum Observation (μg/m^3)				
	1971	1972	1973	1974	Average	1971	1972	1973	1974	Average
Ely	-	-	38	38	38	-	-	201	337	269
Hoyt Lakes	47	45	39	30	40	242	230	174	189	209

* State and Federal Primary Standard: 75 μg/m^3; Secondary Standard 60 μg/m^3) Maximum 24-Hour Concentration: Primary Standard 260 μg/m^3)

6.083 Fiber sampling produced a maximum observation of 82x10^3 fibers/m^3 and an average observation of 13x10^3 fibers/m^3 at Babbitt. The figures for Hoyt Lakes were 31 and 12, respectively.

6.084 Probable Environmental Impacts of Using the Embarrass Site. The impact on potential mineral resources would be minimal. The soils on the site would be covered with tailings and their productivity destroyed. These impacts are comparable to those associated with the Mile Post 7 site.

6.085 Water quality degradation would occur utilizing the Embarrass site in a similar manner to that described for the Mile Post 7 site with some qualification. The streams that would be disturbed at the Embarrass site are warm water streams of lesser recreational fishery value than the cold water streams at the Mile Post 7 site. There are no high quality lakes in close proximity to the site, as is the case of the Mile Post 7 site (Bear Lake).

6.086 Implementation of the Embarrass alternative would result in the same water qulaity benefits to Lake Superior as the Mile Post 7 alternatvie relative to the ending of in-lake disposal of tailings. If the Embarrass site were used, Reserve would have to discharge contact water from the Lakeside Power Plant into Lake Superior. Under the Mile Post 7 plan this water would be used as part of the make-up water for the concentrator plant process recycle system. The volume of this discharge would be about 284 gallons per minute. The water would be high in precipitable solids. A discharge permit from the State of Minnesota would be required. As the discharge would be required to meet State water quality standards, the impacts upon Lake Superior would be minimal.

6.087 Approximately 4.67 miles of warm water feeder streams would be destroyed as compared to the 9.7 miles of cold water streams destroyed with the Mile Post 7 plan. Possible spawning and nursery habitat for warm water fish exists in this area, but a viable fishery is not known to be present. Mud Lake would be filled and destroyed. Kaunonen Lake (13 acres) would become part of the seepage collection system. Also it would be subject to windblown dust.

6.088 Parts of Spring Mile Creek and the outlet creek for Kaunonen Lake, while not within the basin, would be subject to disturbance through dam construction and to the same impacts as discussed for the streams in the Mile Post 7 area that are downstream of the proposed basin.

6.089 Table 11 below, compares the loss of aquatic habitats and biota for the Mile Post 7 and Embarrass plans.

TABLE 11

LOSS OF AQUATIC HABITAT AND BIOTA

Impacts	Mile Post 7	Embarrass
Loss of Aquatic Habitat:		
Streams (Miles)	Big Thirty-Nine Creek 7.0 Little Thirty-Nine Creek 2.7	Spring Mine Creek 3.4 Ridge Creek 1.2 Unnamed Outlet of Kaunonen Lake 0.8(1)
Lakes (Acres)	None	Mud Lake 7 Kaunonen Lake 13(1)
Marshes (Acres)(2)	800	1,230
Fish Tolerance	Trout tolerance	Northern pike walleye and yellow perch tolerance

6.090 All vegetation on the site would be eventually covered and destroyed. The coverage of this site by tailings would result in the loss of 5,888 acres of habitat for a variety of wildlife species. This represents moose habitat of a lesser quality than at Mile Post 7 and deer habitat similar to that of Mile Post 7. Wolf and ruffed grouse habitat of greater quality than Mile Post 7 would be lost. The loss of habitat for snowshoe hare on a per unit area basis would be similar to that of Mile Post 7. The loss of spruce grouse would be less than that of Mile Post 7. In general, the impacts upon wildlife presently using the Embarrass site would be similar to those discussed for the Mile Post 7 site. Also, uncollected seepage from the Embarrass site could raise down-gradient groundwater levels enough to damage vegetation on approximately 3000 acres between the Embarrass basin and the Embarrass River.

(1) These are not covered by tailings but become part of seepage collection system.
(2) Includes total of marshes covered by tailings, but not marshes affected by seepage collection system.

6.091 In addition, approximately 1,200 acres of land would have to be cleared as right-of-way for the new railway, access roads, water pipeline, and power transmission line. This would involve the use of various types of heavy equipment, powered primarily by internal combustion engines, resulting in noise levels and exhaust emissions which would be at least temporarily disruptive to wildlife in the vicinity. There would also be a certain amount of destruction of vegetation and animal habitats in the areas cleared for right-of-way. Once constructed, the right-of-way would be kept clear for maintenance and inspection purposes, forming a corridor which would not otherwise be present.

6.092 An estimated 51,169 C units (100 cubic feet) of pulpwood is found on the Embarrass site. This would be harvested before operations would be started at the basin. The basin would not be able to support vegetation until some time following the cessation of operations. Revegetation plans similar to those for the Mile Post 7 site would probably be developed. At present there are no data on the value of agriculture for the Embarrass alternative. There are some small private landholdings on the north edge of the Embarrass site. A few of these owners have truck patches, raise livestock or cut hay. All are marginal farms. If this site were selected for a tailings basin, these farms would be forced out of production.

6.093 All impacts on housing and public services during the construction phase which were identified for the Mile Post 7 proposal are also applicable to the Embarrass site, with respect to the impacts themselves and the extent of the impacts. The exception to this is the possibility of the establishment of a construction camp in or near Babbitt. At the end of the construction phase, the camp could be converted into residences for permanent employees during the operation phase.

6.094 The impact on housing occurring as a result of the implementation of the Embarrass alternative would be dependent on the number of new Babbitt employees who could be hired, if need be, from the surrounding area, and the number of Silver Bay employees who would move to Babbitt and could sell their houses in Silver Bay and buy new houses in the Babbitt vicinity. This last factor may be the most limiting of all due to the diminished market for houses in Silver Bay.

6.095 Those persons relocating from Silver Bay and other North Shore communities would have to compete for a limited supply of housing with those associated with the expansion of other taconite companies on the Iron Range, with those displaced by the Embarrass site, if chosen, and with those support industry personnel seeking housing. The total number of persons seeking housing in Iron Range communities could reach 1500-1800 (1350-1440 persons associated with the Reserve personnel relocating, 60-80 displaced by utilization of the Embarrass site, approximatley 25 people associated with support industry personnel) in addition to those 3,800 whose housing needs have been identified in connection with the expansion of existing taconite operations of the Range. Some Iron Range communities would find it difficult in the short term to provide the services, particularly water and sewer services, to meet expanded population needs.

6.096 As in the case of housing, the impact on the educational sector cannot be determined without knowing the number of employees who would move to Babbitt. The current excess capacity in the Babbitt district could handle most, if not all, of the new student influx. Any increase beyond the existing capacity would have to be met either by expanding the facilities and hiring more teachers or by shifting some of the student load to nearby school districts, which are also currently operating with excess capacity.

6.097 Population changes resulting from the construction of an inland concentrator and tailings basin would depend upon the location and origin of the construction labor supply. However, it is anticipated that most, if not all, of the labor force would already be in the area. Therefore, no significant additional regional population increase would be expected.

6.098 Little or no change in tax base or tax receipts would be expected during the construction period. During operations, it is estimated that there would be a net reduction in the taxes receivable by Lake County. This is based on present laws governing the distribution of taconite tax and the fact that the concentrator would be moved out of Lake County into St. Louis County. St. Louis County would most probably benefit from the changes and relocation. These impacts would require an addition to the Lake County residential taxes which could occur as a result of increase in property tax levees induced by a reduction in revenues from taconite taxes. Should this occur, the tax burden would be transferred to the residents of Lake County. Legislative action restoring the previous tax distribution between the two counties may be the most effective remedy of this impact. It is estimated that there would be no net reduction of State and local taxes payable by Reserve at any of the alternatives. Total State taxes payable are estimated to range from $597 million to $631 million over the 40-year project life. Federal taxes payable by the parent companies over the 40-year life are estimated to vary from $814 million to $940 million.

6.099 Approximately 450 to 480 employees are expected to be needed if the on-land tailings disposal system and new concentrator/fine crusher facilities were built at the Embarrass site. In the short term, it is assumed that most affected employees at the Silver Bay operation would follow their jobs to the new site by daily or weekly commuting.

6.100 Depending on the commuting-versus-moving decisions by the Silver Bay and North Shore area residents employed at the new site, secondary employment in retail and services business would develop in the area in which the employees decide to reside. Significant impacts would develop when numbers of permanent residents are changed by employees moving from Silver Bay to the Babbitt area, with those communities gaining population being most likely to experience economic expansion. Silver Bay could experience the greatest loss of population and reduction in economic base, depending on the present opportunities and future community action.

6.101 A substantial in-migration of people would generate demand for retail-commerical and services-based businesses. If the local employment multiplier applies, about one new job is generated for every two mining jobs; on a regional basis the multiplier suggests one new job for each mining job.

6.102 Population changes would vary depending upon a number of related elements that may generate various changes. The following is a compliation of the factors that would limit shifts or significant changes in population in the short run:

1. As described previously, there are currently no housing units available in sufficient number to house Silver Bay employees who would transfer, or new employees who would move, into the vicinity of Babbitt. In addition, Silver Bay employees would probably be unable to sell their homes except at a loss, especially in the short term.

2. Daily or weekly commuting would probably not be a long-term solution based upon the tenativeness of construction of Forest Road 11, increased gasoline prices, adverse weather, and road maintenance problems.

3. Current family income of Reserve employees in comparison with new housing costs would minimize the opportunity to purchase or rent new housing on the Iron Range.

4. Alternate employment centers for short-term employment (such as Two Harbors or Duluth) exist within commuting distances. However, there are limited opportunities available there.

5. As attrition reduces the labor force in the pelletizer, employees not wishing to continue to work in the concentrator in its new, more distant location may take openings in the Silver Bay facilities. This would reduce relocation or commuting. However, Reserve estimates it would take 10 years for normal attrition to open up enough positions; and that it is highly unlikely concentrator personnel would have the necessary skills to assure pelletizer positions.

6.103 In general, a combination of two elements can be expected to characterize the locational nature of the population under the Embarrass alternative. These include some persons remaining in Silver Bay and commuting and some relocation to the Babbitt area. As the life of this alternative is extended, the Silver Bay area would have experienced a net loss of population approximately equal to the number of employees in the concentrator plus their average family size (1,200 to 1,500). The Babbitt area would experience a like net increase in population. It is important to note that a significant degree of personal choice would influence the outcome and nature of population relocations.

6.104 The net loss of population of 1200 to 1500 at Silver Bay (assuming an Embarrass site) would have severe economic effects on the economy of Silver Bay, since the loss would constitute approximately one-half of the town's total population. Those leaving would find it difficult if not impossible to sell their houses in order to purchase a home elsewhere. Those remaining would face increased taxation and reduced community services. Those employed in the service sector would face sharply reduced income or job loss as the expenditures of the 1,200 to 1,500 persons are transferred to communities near the Embarrass site.

6.105 Before the Embarrass site could be used, an archaeological survey of the site would have to be conducted as would further investigation of the Indian camp remains and trail near the site.

6.106 Utilization of the Embarrass site by Reserve could necessitate modification of expansion plans for the Erie Mining tailings basin. However, preliminary Erie Mining plans indicate that their tailings basin expansion could be accommodated without encroaching on the Embarrass site.

6.107 Using the Embarrass site would have negligible impact upon fishing activity in the area as the streams contain poor fishing habitats. Hunting activity currently on the site may be high due to the proximity of population centers. Therefore, industrial use of the 5,888 acres of wildlife habitat present on the site would eliminate all hunting activity currently taking place there.

6.108 Approximately 4 miles of County Road 104 would be covered. In addition, two local roads which connect County Road 104 with County Road 21 would be partially covered. However, access to property served by these two roads would still be provided by County Road 21.

6.109 The area most vulnerable to visual impacts would be north of the site on County Road 21. This area is basically open, consisting of pasture lands and swampy vegetation. Approximately 150-200 homes are located in this area and would be susceptible to visual impact.

6.110 Since the State of Minnesota public hearings and the development of the concept of disposing of all tailings under water, no new air emission projections for the Embarrass site have been made taking this design concept into account. The table below contains the projected particulate emissions for the original concept of disposal of some coarse tailings above the water level in the basin.

TABLE 12

PROJECTED IMPACT ON TSP LEVELS IN POPULATION CENTERS - WITH MITIGATION

		Mean Annual TSP Concentrations (µg/m³)						
		Existing	Increases by Phase					
				Embarrass				
Population Center	Population	Air Quality	C	0-14	14-17	17-20	20-40	
Aurora	2,531	40	3	1	3	1	1	
Babbitt	3,076	45	7	1	7	3	3	
Beaver Bay	362	40	1	<1	1	<1	<1	
Hoyt Lakes	3,634	40	4	1	4	2	2	
Silver Bay	3,504	30	1	<1	1	<1	<1	
Tower	699	35	4	1	4	2	2	

C = initial construction phase; operations phases are indicated by time period in years.

One of the primary reasons why the Embarrass and the other two Babbitt alternatives are not preferred by the DNR and MPCA is that high TSP levels in Babbitt from mining operations in the area would be further aggravated by the locating of a tailings disposal site in the area.

6.111 The increase in noise levels during the construction phase for the Embarrass alternative would affect 1,700 acres and 9 residences as compared to 670 acres and no residences for the Mile Post 7 plan. During operations, noise from the Embarrass operations would have impact on 2,100 acres and 10 residences and compared to 3,350 acres and no residences for Mile Post 7.

6.112 Tables 13 and 14, below, show a comparison of the energy costs for the Embarrass and proposed Mile Post 7 plans.

TABLE 12

ENERGY REQUIRED FOR CONSTRUCTION OF NEW FACILITIES

	Mile Post 7		Embarrass	
	Tons	Equivalent BTU's	Tons	Equivalent BTU's
1. Fixed steel	25,080	907×10^9	51,050	$1,846 \times 10^9$
2. Moveable Steel	20,600	$1,336 \times 10^9$	37,650	$2,441 \times 10^9$
3. Cement	9,800	75×10^9	11,300	87×10^9
4. Sand	27,200	2×10^9	31,700	3×10^9
5. Gravel	37,000	10×10^9	43,500	12×10^9
6. Lumber	780	3×10^9	2,457	8×10^9

TABLE 13 (cont.)

7.	Copper	70	4×10^9	250	15×10^9
8.	Aluminum	—	—	300	53×10^9
9.	Excavation	7.15×10^6	610×10^9	7.88×10^6	655×10^9
10.	Architectural	2,700	128×10^9	4,700	223×10^9
	TOTAL EQUIVALENT BTU'S	$3,075 \times 10^9$		$5,343 \times 10^9$	

TABLE 14

ANNUAL ENERGY REQUIREMENTS FOR RESERVE MINING TACONITE OPERATIONS (equivalent BTU's)

Category	Mile Post 7	Embarrass
1. Operation of facilities	$20,788 \times 10^9$	$22,766 \times 10^9$
2. Transportation of materials	843×10^9	612×10^9
3. Transportation of personnel	—	13×10^9
4. Construction of new facilities*	77×10^9	134×10^9
5. Total energy requirements	$21,708 \times 10^9$	$23,525 \times 10^9$
6. Energy required per long ton of taconite pellets produced	2,285,053	2,198,598
7. Energy per long ton for tailings distribution, process steam, transmission loss, and make-up water pumping	1,500	188,750
8. Total Energy per long ton of pellets	2,286,553	2,387,348

*Construction energy costs prorated over 40-year project life to obtain annual costs.

As can be seen from the tables, the Embarrass plan has a higher total energy cost. At the Embarrass site, 10.7 million tons of pellets per year could be produced as compared to 9.5 million tons per year with the Mile Post 7 plan. The Mile Post 7 plan is more economical in terms of energy expended per unit of product produced.

6.113 There are numerous adverse environmental impacts associated with both the proposed Mile Post 7 plan and the Embarrass alternative site. The most salient points in terms of environmental preferability of the Embarrass site over the Mile Post 7 site are listed below:

a. Aquatic habitat of less quantity and much lower quality would be lost or degraded with the Embarrass plan.

b. There would be much less potential for water quality degradation with the Embarrass plan.

c. Lower quality terrestrial habitat in terms of diversity would be lost at the Embarrass site.

d. There is less potential for degradation of existing and planned recreational facilities at the Embarrass site.

6.114 The Mile Post 7 site is advantageous to Reserve and its employees primarily for the following reasons:

a. There would be lower initial costs and less capital investment with the Mile Post 7 site as compared to the Embarrass site.

b. There would be no disruption in the living patterns of the 450 to 480 Reserve employees who would find their place of employment shifted from Silver Bay to the Babbitt area with the Embarrass alternative.

c. Less energy would be expended per unit of product produced with the Mile Post 7 plan.

d. Implementation of the Embarrass plan would take about 2½ years longer than the Mile Post 7 plan.

Colvin Site (1)

6.115 Facilities and Operation. The Colvin tailings disposal area would be located in the upper Partridge River watershed, about 4 miles southeast of the Peter Mitchell Mine and adjacent to the Reserve railroad (exhibit 35). The utilization of the Colvin site would require newly construced rail, car dumping, fine crushing, dry cobbing, concentrating, concentrate filtering, concentrate loading, and tailings disposal facilities (exhibit 56). The concentrate filter cake would be transported to Silver Bay in insulated railroad cars where the concentrate would be unloaded and fed to the existing pelletizing plant. The new facilities would be essentially the same as described for the Embarrass alternative. These new facilities

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(1) State of Minnnesota, 1975.

at the Colvin site would be constructed on the ridge at the north end of the basin. Utilities would also be the same, except for the shorter length of the electrical transmission line. New facilities for rail haulage of the coarse crushed taconite ore and concentrate filter cake would differ from those discussed for the Embarrass alternative.

6.116 Rail Haulage of Coarse Crushed Ore. Coarse crushed taconite ore would be loaded into 85-ton railroad cars at crusheres nos. 1 and 2. These cars would then be assembled into unit trains that would carry the crushed taconite approximately 7 miles to the car dumper at the Colvin site. This would require the construction of a railroad spur from the present Reserve railroad and a car yard at the Colvin site.

6.117 Rail Haulage of Concentrate. Concentrate filter cake would be hauled approximately 40 miles from the Colvin site to Silver Bay on Reserve's private railroad in 85-ton railroad cars. Insulated, open-top cars, as described for the Embarrass alternative, would be used to retard freezing of the wet concentrate filter cake during winter months. See paragraph 6.056 page 94 for a further discussion of the need for a Research and Development program to perfect this concept.

6.118 Dam Construction. The Colvin site is located in the upper Partridge River watershed which is also tributary to the St. Louis River basin. This tailings basin would be developed by construction of dams along the southern and western limits, using natural topography along the remainder of the basin.

6.119 As with the Embarrass site, the Colvin site would be developed in two stages. The north Colvin basin would be developed first, by construction of a starter dam near the east quarter corner of Section 25, T59N, R13W. The starter dam would be constructed from borrow material, and the dam would be raised and extended using tailings. The tailings basin would be raised to an ultimate height of approximately 1,600 feet. During the final stages of development in the north Colvin basin, a dike would be constructed using tailings to create the south Colvin basin.

6.120 Again, separation of the Colvin site into a north and south basin enables better control of tributary drainage area during periods of heavy runoff. Also, the impact on quantity of runoff downstream of the basin is minimized, since the drainage area removed from the Partridge River watershed at any one time is reduced.

6.121 Tailings Disposal. Tailings disposal would be the same as that proposed for the Embarrass site.

6.122 Seepage Collection System. A seepage collection system on the outside of the basin would intercept seepage through the dams and runoff from the outside dam slopes. This system would consist of an intercepting ditch and dikes to collect the combined seepage and runoff. Temporary storage ponds and pump stations would collect and return water to the basin. Because the seepage collection system would generally be located from 600 to 1,000 feet outside of the top of the dam, an additional drainage area, located between the seepage collection ditches and top of dam, would be added to the watershed tributary to the basin. Criteria for design of the collection system and return water pumping stations are based on the estimated seepage rate, plus pumping capacity and temporary storage to collect a 10-year frequency runoff event from the drainage area tributary to the collection system.

6.123 Stream Diversions. Construction of diversion facilities within the tributary drainage area would be required to direct runoff as desired during operations. Following completion of the north Colvin basin, the outlet of Big Lake and a portion of the tributary area lying southeast of the north basin would be diverted to the west, into the south Colvin site. Following stabilization of the north Colvin basin, runoff from this site could be treated and released to the Partridge River.

6.124 Access Roads. Access corridors from existing roads would be required in the vicinity of the Colvin site. An existing road runs within about one-half mile of the tailings basin limits. Access roads around much of the basin perimeter would also be required, as well as a pipeline maintenance road between the basin and the plant. It is likely that the cleared access width to the basin area would be in the range of 100 to 200 feet, with a road width of about 30 feet. Additional access corridors would be required for construction of the plant facilities. In the case of Colvin, the potential plant site lies within about one-quarter mile of an existing road. Access routes would likely be limited in width to a cleared area of about 100 to 150 feet with a surface width of from 30 to 40 feet. A new 75-MW power line similar to that described for the Embarrass site would be necessary for the Colvin site.

6.125 Environmental Setting. The bedrock at the Colvin site is the Duluth Gabbro Complex. There seems to be some rise in bedrock from northwest to southeast. This results in bedrock control contributing to the formation of the low ridge on the southeast side of the site.

6.126 The site has good to high potential for copper-nickel resources. The major part of this potential must, on present knowledge, be assigned to the basal zone some thousands of feet below the surface. Mining would therefore be restricted to underground methods.

6.127 The soils on the site are primarily sandy loams and glacial till developed from glacial deposits.

6.128 The Partridge River watershed, in which the Colvin site lies, can be described as rolling to hilly timberland with rather extensive swamps and lakes throughout the basin. A large area near the north limits of the watershed is occupied by open pit mines. These mining areas are dewatered by pumping on a continuous basis, thereby returning precipitation and runoff collected within them to the watershed. The effect of the mining areas on runoff is similar to the effect of lakes and marshes in temporarily storing runoff within the watershed. Colby Lake and the Whitewater Reservoir, adjacent to Hoyt Lakes, serve as reservoirs operated by Erie Mining Company to provide water supply for the Erie taconite operation. Operation of these reservoirs and the open pit mines has a moderating effect on streamflow in the Partridge River.

6.129 The stream network within the watershed is similar to that for the Embarrass River. Smaller tributaries form in the steeper slopes along the perimeter of the basin and drain to the Partridge River which flows through an extensive swamp or marsh along the middle portion of the watershed. A major tributary to the Partridge River is Colvin Creek which originates in the southeast portion of the watershed. The Colvin alternative site is so named because a portion of the proposed tailings basin is located on this tributary stream. Big Lake, located in the southeast portion of the watershed, is also tributary to the Partridge River through an unnamed stream entering about 2 miles upstream of Colvin Creek. This stream also traverses the potential Colvin tailings basin site. Other tributaries to the Partridge include Second Creek, Wyman Creek, Longnose Creek and Wetlegs Creek which are all tributary from the north.

6.130 The Colvin site is generally characterized by bedrock at or near the surface. As a result, groundwater levels are also at or near the surface being controlled by the impermeable bedrock. As on the Embarrass site, steep bedrock gradients result in steep groundwater gradients which produce bog areas at their base. The permeability of the soil from the Colvin site generally ranges from 10^{-6} to 10^{-4} centimeters per second (.09 to 9 feet per month). The piezometric map for the Colvin site indicates that groundwater levels closely follow surface topography. Groundwater levels are generally 5 to 20 feet below the existing ground surface. Local outlets for the goundwater are the several streams that flow through the area.

6.131 Three streams flow within the Colvin site: Colvin Creek, Cranberry Creek, and the south branch of the Partridge River. The approximate lengths of streams within the basin boundaries are as follows: Cranberry 1.7 miles, Colvin 4.4 miles, south branch of Partridge River 4.9 miles, north tributary of the south branch of Partridge River 2.3 miles, and the south tributary 0.8 mile.

6.132 Data for Colvin Creek, the south branch of the Partridge River, Cranberry Creek, and Big Lake in particular support the general findings that these water bodies are relatively free from pollution and capable of supporting an excellent fishery. However, the species of fish and organisms found in these water differ from those that characterize the Mile Post 7 area.

6.133 Colvin Creek is a warm water feeder stream, with a swamp and forest drainage, and is the largest stream within the Colvin tailings basin site boundary. The bottom is composed of approximately 70 percent gravel, rock or sand, with the remaining 30 percent muck, detritus, or clay. The sportfish it supports are primarily northern pike (Esox lucius), walleye (Stixostedien vitreum), and yellow perch. The south branch of the Partridge River supports a similar fishery. Cranberry Creek is a warm water feeder stream with drainage characteristics like those of Colvin Creek and the south branch of the Partridge River.

6.134 Big Lake is 793 acres and lies approximately 1½ miles southeast of the Colvin site. The lake is approximately 2½ miles long and one-half to three-fourths mile wide. Big Lake is unique, for unlike many of the lakes and rivers in this area it does not have the typical bog-stained deep brown color. The lake is not surrounded by bog drainage or swamp communities, for the topography is somewhat higher and bog drainage into the lake is reduced. Another characteristic of the lake is a very sandy bottom. Silt and detritus were evident only in the confined coves or small bays. Otherwise, the bottom is relatively clean sand, gravel and rocks. The lake has an extremely large number of boulders, particularly along the shoreline. It supports an excellent fishery and offers a wide variety of sport fishing. This clean, natural lake provides its native fish with biological success; relatively undistrubed by humans, it has maintained itself and has arrived at an apparently balanced predator-prey relationship which would certainly continue if left free from major disturbance.

6.135 Seven Beaver Lake and Round Lake are located approximately 4 miles southeast of the Colvin site. These lakes are the headwater source of the St. Louis River. Seven Beaver Lake is the larger of the two, with an area of 1,410 acres as compared to 311 acres for Round Lake. Both are relatively shallow lakes. They are classified as soft water lakes and are managed for walleye by the Minnesota Department of Natural Resources. The lakes are completely surrounded by a mature upland forest, spruce swamp and peat bog communities which restrict accessibility.

6.136 Round Lake has only one inlet and its single outlet flows directly into Seven Beaver Lake. Seven Beaver Lake has two additional inlets, the East River and North River, and one outlet, the St. Louis River. The channel connecting Seven Beaver Lake with Round Lake is quite wide and only one-fourth mile long.

6.137 Lake shoals as well as the outlets of Seven Beaver Lake were composed of nearly equal parts of muck-detritus and rubble, while at the inlets, the bottom was entirely muck and detritus. At Round Lake, the substrate at the inflow is primarily muck with some rubble, and at the outlet it is entirely muck and detritus.

6.138 Even though bottom habitat diversity appears to be low, benthic invertebrate production and species diversity both appear to be high.

6.139 Fish collections made at each lake by the Minnesota Department of Natural Resources indicate that the four major species present are walleye, yellow perch, northern pike and white sucker. Fish production in the lakes appears to be good and exceeds State-wide median levels. Despite the remote location and limited accessibility of the lakes, fishing pressure is reportedly very heavy. Fishing success is good although few large sport fish have been taken.

6.140 The limited water quality and aquatic biota data available on the Colvin site are on file in the St. Paul District Office, Corps of Engineers.

6.141 The Colvin site is vegetated primarily by the same aspen/white birch forest that is found on the Mile Post 7 site. The site does not have the diversity of forest types found at the Mile Post 7 site. The only other major forest types on the Colvin site are black spruce and jack pine (exhibit 57).

6.142 The site differs from Mile Post 7 in that portions of it have been cut over in the last 7 to 8 years. About 23 percent of the site is wetlands.

6.143 The site supports the same species of wildlife that the Mile Post 7 site does; however, it offers better white-tailed deer habitat than the Mile Post 7 site does. The Colvin site also has more favorable habitat for aquatic furbearers, ruffed grouse, moose, and spruce grouse. The Colvin site lies within the major range of the eastern timber wolf.

6.144 As the Colvin site is in the Babbitt area, the socioeconomic setting is the same as for the Embarrass alternative.

6.145 The Colvin site is within the Superior National Forest and a major portion (55 percent) is owned by the Federal Government. It is managed under a multiple use - sustained yield program. Man-made facilities on the site include light duty roads, Indian trails, and an abandoned logging railroad. The site is not inhabited and no structures presently exist there.

6.146 The only known cultural features on the site are two Indian trails crossing the site.

6.147 The streams on the site offer good fishing but pressure is relatively light because of poor access. The site has a State-designated snowmobile trail crossing it.

6.148 Over half of the site lies within the proposed U.S. Forest Service Seven Beaver Recreation Area. This recreation area is proposed to be primarily water-oriented in activity, and has been assigned the second priority among the eight multiple-use areas being proposed by the Forest Service for the Superior National Forest.

6.149 Access to the Colvin site is via Forest Route 113 off Forest Route 120 through the city of Hoyt Lakes. Forest Route 113 is of minimal standards and becomes a primitive road midway through the Colvin site.

6.150 The air quality for the site is similar to that of the Embarrass site. Hoyt Lakes is about 13 miles east of the site. Table 8 gives the existing air sampling data for Hoyt Lakes.

6.151 Probable Environmental Impacts of Using the Colvin Site. As there is copper-nickel mineral potential on the site, conflicts could occur if it were used as a tailings basin. The tailings would make access to the minerals more difficult and increase the costs of exploration during the active life of the basin. However, because mines at the sites would have to be deep mines, the likelihood that these minerals would be exploited is small.

6.152 Impacts on soils would be the same as discussed for the Mile Post 7 site.

6.153 The impacts on water quality associated with the Colvin site are generally comparable to those discussed for the Mile Post 7 site with respect to the manner in which surface and groundwater would be affected by construction and operation activities.

6.154 The impacts on Lake Superior would be the same as discussed for the Embarrass alternative.

6.155 Warm water streams would be affected at the Colvin site as compared to cold water streams at the Mile Post 7 site. The shorter pipeline and lack of stream crossings would reduce the potential for water quality degradation due to pipeline failures.

6.156 Table 15, below, compares the loss of aquatic habitats and biota under the Colvin and Mile Post 7 plans.

TABLE 15

LOSS OF AQUATIC HABITAT AND BIOTA

Impacts	Mile Post 7	Colvin
Loss of Aquatic Habitat:		
Streams (Miles)	Big Thirty-Nine Creek 7.0 Little Thirty-Nine Creek 2.7	South Branch Portage River 6.3 Colvin Creek 4.4 Cranberry Creek 2.3
Lakes (Acres)	None	None
Marshes (Acres)	800	2,260
Fish Tolerance	Trout Tolerance	Northern pike, walleye, & yellow perch tolerance

6.157 The potential for impacts upon aquatic habitats in the streams and lakes near the Colvin site is similar to that discussed for those in the area of the Mile Post 7 site.

6.158 The use of the Colvin site would entail the loss of 6,488 acres of wildlife habitat. This represents a loss of fair moose habitat, good (and improving) deer habitat, and fair to good habitat for black bear. In addition, there is a deer wintering area which partially intrudes into the Colvin site. Snowshoe hare are abundant on this site and the

loss of habitat would adversely affect this population. This site provides higher quality habitat and food supply for timber wolves than the Mile Post 7 site. The removal of this acreage would adversely affect wolf habitat. Riparian and semi-aquatic furbearer habitat would be lost or displaced. The effects upon wildlife presently using the site would be the same as discussed for the wildlife using the Mile Post 7 site.

6.159 All vegetation on the site would be destroyed. There is an estimated 63,311 C units of pulpwood on the site that would be harvested before the site would be used as a tailings basin.

6.160 The socioeconomic impacts would be similar to those discussed above for the Embarrass alternative.

6.161 Before the Colvin plan could be implemented, an archaeological survey of the site would need to be conducted to determine if there are any presently unknown archaeological resources in the basin area. The two Indian trails crossing the site would be covered and destroyed by construction of a tailings basin.

6.162 The Colvin alternative would probably have little impact upon fishing activity on the site as fishing pressure has been reported to be low due to limited access. If access to these lakes were improved, adverse impacts upon the trout stream and lakes in the area could have a greater impact on fishing activity; however, improvement of access is not currently planned.

6.163 The impact upon the proposed Seven Beaver Recreation Area could be substantial. This alternative would cause a significant decrease in the size of the recreation area and could have a detrimental impact upon the remainder of the area, thus reducing attendance and activities at the park. See paragraph 6.293 under the Midway alternative for the discussion of procedures involved in the procurement of U.S. Forest Service Land.

6.164 The effect upon hunting activity in the area would probably be directly related to the effect upon game animals. As mentioned, this area currently provides fair habitat for moose, good habitat for deer, and fair to good habitat for black bear. Game bird populations are not abundant. The site supports more furbearers than the Mile Post 7 site does.

6.165 There would be a loss of 15 miles of non-State designated recreational trails if the Colvin site were used.

6.166 A portion of Forest Route 113 would be covered by tailings. As this road is only used as access into the site, it would not be replaced.

6.167 The only point where visual impact would occur would be along Forest Route 120 approximately 1.25 miles southwest of the Colvin site.

6.168 Since the State of Minnesota public hearings and the development of the concept of disposing of all tailings under water, no new air emission projections for the Colvin site have been made. The table below contains the projected particulate emissions for the original concept of disposal of some coarse tailings above the water level in the basin.

TABLE 16

PROJECTED IMPACT ON TSP LEVELS IN POPULATION CENTERS - WITH MITIGATION

			Mean Annual TSP Concentrations ($\mu g/m^3$)				
			Increases by Phase				
				Colvin			
Population Center	Population	Existing Air Quality	C	0-13	13-16	16-19	19-40
Aurora	2,531	40	2	<1	2	1	1
Babbitt	3,076	45	6	1	6	3	3
Beaver Bay	362	40	1	<1	1	<1	<1
Hoyt Lakes	3,634	40	3	<1	3	1	1
Silver Bay	3,504	30	1	<1	1	<1	<1
Tower	699	35	2	<1	2	1	1

C = initial construction phase; operations phases are indicated by time period in years.

With the Colvin plan, the air emission impacts would be shifted from North Shore communities to inland communities. The residents of these communities would be subjected to an increased health risk from airborne fibers. Babbitt would be the city most affected of the inland communities.

6.169 Noise levels during the construction phase would affect 2,600 acres as compared to 630 acres for the Mile Post 7 plan. During the operations phase, increased noise levels would affect 6,500 acres for the Colvin plan as compared to 3,350 acres for the Mile Post 7 plan.

6.170 Tables 17 and 18, below, outline the expected energy requirements using the Colvin and the Mile Post 7 sites.

TABLE 17

ENERGY REQUIRED FOR CONSTRUCTION OF NEW FACILITIES

	Mile Post 7		Colvin	
	Tons	Equivalent BTU's	Tons	Equivalent BTU's
1. Fixed steel	25,080	907 x 10^9	51,050	1,846 x 10^9
2. Moveable steel	20,600	1,336 x 10^9	37,650	2,441 x 10^9
3. Cement	9,800	75 x 10^9	11,300	87 x 10^9
4. Sand	27,200	2 x 10^9	31,700	3 x 10^9
5. Gravel	37,000	10 x 10^9	43,500	12 x 10^9
6. Lumber	780	3 x 10^9	2,457	8 x 10^9
7. Copper	70	4 x 10^9	250	15 x 10^9
8. Aluminum	--	--	300	53 x 10^9
9. Excavation	7.15 x 10^6	610 x 10^9	7.88 x 10^6	655 x 10^9
10. Architectural	2,700	128 x 10^9	4,700	223 x 10^9
TOTAL EQUIVALENT BTU'S	3,075 x 10^9		5,343 x 10^9	

TABLE 18

ANNUAL ENERGY REQUIREMENTS FOR RESERVE MINING TACONITE OPERATIONS (equivalent BTU's)

Category	Mile Post 7	Colvin
1. Operation of facilities	20,788 x 10^9	22,028 x 10^9
2. Transportation of material	843 x 10^9	455 x 10^9
3. Transportation of personnel	--	10 x 10^9
4. Construction of new facilities*	77 x 10^9	134 x 10^9
5. Total energy requirements	21,708 x 10^9	22,627 x 10^9
6. Energy required per long ton of taconite pellets produced	2,285,053	2,114,613
7. Energy per long ton of pellets for tailings distribution, process steam, transmission loss, and make-up water pumping	1,500	188,820
8. Total energy per long ton of pellets	2,286,553	2,303,433

* Construction costs pro rated over 40-year life of project.

6.171 Implementation of the Colvin plan would take about 2 1/2 years longer than the Mile Post 7 plan. The Mile Post 7 plan would require less total energy and would require less energy per unit of product produced. The Colvin alternative would produce 10.7 million tons of pellets per year while the Mile Post 7 plan would produce 9.5 million tons per year.

6.172 Use of either the Mile Post 7 site or the Colvin site would have significant adverse environmental impacts. Use of the Mile Post 7 site would eliminate or adversely affect high quality cold water aquatic habitat while use of the Colvin site would eliminate or adversely affect high quality warm water aquatic habitat on about the same scale.

6.173 The terrestrial habitat that would be lost on the Mile Post 7 site is more diverse but of lower quality for game species than that on the Colvin site.

6.174 The Mile Post 7 site lies close to existing and planned State parks and a county recreation area while the Colvin site is part of a recreation area planned by the U.S. Forest Service.

6.175 The Mile Post 7 plan is more advantageous to Reserve for two primary reasons, i.e., cost and employee welfare.

Snowshoe Site [1]

6.176 Facilities and Operation. The Snowshoe tailings disposal area would be located approximately 7 miles southeast of the Peter Mitchell Mine and adjacent to Reserve's railroad (exhibit 53). The utilization of the Snowshoe site would require the construction of new rail, car dumping, fine crushing, coarse cobbing, concentrating, concentrate filtering, concentrate loading, and tailings disposal facilities. The concentrate filter cake would be transported to Silver Bay in insulated railroad cars, where the concentrate would be unloaded and fed to the existing pelletizing plant.

6.177 The new facilities would be constructed on a small ridge southwest of the basin (exhibit 58). Facilities for fine crushing, dry cobbing, concentrating, concentrate filtering, concentrate loading, concentrate unloading and handling, and tailings separation and filtering would be essentially the same as described for the Embarrass alternative. Utilities would also be the same, except for the shorter length of the electrical transmission line. However, new facilities for rail haulage of coarse crushed taconite ore and concentrate filter cake and tailings transport and water recycling would differ from those for the Embarrass alternative.

(1) State of Minnesota, 1975

6.178 Rail Haulage of Coarse Crushed Ore. Coarse crushed taconite ore would be loaded into 85-ton railroad cars at crushers nos. 1 and 2. These cars would be assembled into unit trains that would carry the crushed taconite approximately 10 miles to the car dumper at the Snowshoe site. This would require the construction of a railroad spur from the present Reserve railroad and a car yard at the Snowshoe site.

6.179 Rail Haulage of Concentrate. Concentrate filter cake would be hauled in insulated, open-top railroad cars approximately 40 miles from the Snowshoe site to Silver Bay on Reserve's railroad. See paragraph 6.056 for a discussion of the necessary Research and Development program.

6.180 Tailings Transport and Water Recycling. Coarse (cobbed and filtered) tailings would be transported to the basin by 120-ton trucks. These coarse tailings would be used for dam and road construction or placed in the basin. The fine tailings would be pumped from the clarifiers to the basin.

6.181 Dam Construction. The potential Snowshoe tailings disposal area is located northeast of the Colvin site. The Snowshoe tailings disposal area was originally proposed by IECO (International Engineering Company). The basin has been considerably reduced in area from the original proposal, resulting in a greater required dam height than at the Colvin or Embarrass sites. Selection of the basin limits was based primarily on engineering judgment and anticipated reduced costs for dam construction. The Snowshoe area has flat terrain, and clearing and peat removal would be necessary. It would be necessary to pump fine tailings to the basin. The small basin surface area would offer advantages in minimizing the accumulation of runoff within the basin during wet cycles; however, problems during drought cycles would be accentuated.

6.182 No staging was incorporated into the Snowshoe alternative site due to dam construction requirements and its comparatively smaller surface area.

6.183 The basin would be created initially by construction of a starter dike along the western basin limits. A dam constructed of coarse tailings would then be required around the entire basin perimeter. The basin would rise during a period of 40 years to an ultimate elevation of 1,820 feet. The basin occupies an area primarily tributary to the Dunka River. A small portion along the east limits of the basin may be tributary to the North River upstream of Seven Beaver Lake. However, since this area is rather small, and a detailed field survey would be required to identify the actual divide between the Dunka and North Rivers, for practical purposes the east limits of the basin are assumed to approximately follow the divide. This watershed divide is part of the Laurentian Divide, separating runoff of the Dunka River watershed (tributary to Hudson Bay) from runoff of the North River (tributary to the St. Lawrence Seaway).

6.184 Tailings Disposal. Tailings disposal would be the same as for the Embarrass and Colvin alternatives, except that, because of the larger proportion of tailings used in the dams of Snowshoe, the density is greater (about 115 pounds per cubic foot). This higher density allows a lower storage volume of 420,000 acre-feet or 680 million cubic yards.

6.185 Seepage Collection System. A seepage collection system on the outside of the basin would intercept seepage through the dams and runoff from the outside dam slopes. This system would consist of an intercepting ditch and dikes to collect the combined seepage and run-off. Temporary storage ponds and pump stations would collect and return the water to the basin. Because the seepage collection system is generally located from 500 to 1,000 feet outside of the top of dam, an additional drainage area, located between the seepage collection ditches and top of dam, would be added to the watershed tributary to the basin. Criteria for design of the collection system and return water pumping stations are based on the estimated seepage rate, plus pumping capacity and temporary storage to collect a 10-year frequency runoff event from the drainage area tributary to the collection system.

6.186 Access Roads. Access corridors from existing roads in the vicinity of the Snowshoe site would be required. An existing road runs within about one-half mile of the potential tailings basin limits. Access roads around the basin perimeter would also be required, as well as a pipeline maintenance road between the basin and the plant. It is likely that the cleared access width to the basin area would be in the range of 100 to 200 feet with a road width of about 50 feet. Additional access corridors would be required for construction of the plant facilities. The Snowshoe site could require an access road approximately 2.5 to 3 miles in length. Access routes would likely be limited in width to a cleared area of about 100 to 150 feet with a surface of 30 to 40 feet.

6.187 Makeup Water Pipeline. Makeup water requirements would be the same as discussed for the Embarrass alternative.

6.188 Environmental Setting. The bedrock of the Snowshoe site is the Duluth Gabbro Complex. Bedrock on this site is estimated at a maximum depth of 40-50 feet below the surface. Sandy glacial till overlays the bedrock and serves as a base for the extensive bog areas present on the site.

6.189 There is a potential for copper-nickel mineral resources on the site to the same extent as discussed for the Colvin site.

6.190 The Snowshoe site covers about 6 square miles of peat land along the west margin of a large peat bog known as the "One Hundred Mile Swamp" covering about 40 square miles in St. Louis and Lake Counties. This bog has potential for commercial peat development. Preliminary soil tests indicate it ranges up to 20 feet in depth and is composed primarily of humic peat which has potential as an energy source with related petrochemical by-products.

6.191 The Snowshoe site lies primarily in the Dunka River watershed. The Dunka River watershed can be described as gently rolling to hilly land with extensive storage in the form of swamps. As with the Partridge River watershed, a portion of the Dunka basin is occupied by the Reserve open pit mine. The mining area is dewatered on a continual basis with discharge to the Dunka River. The effect of the open pit mine again is similar to the effect of storage in the swamps.

6.192 The central portion of the watershed is relatively steep, sloping generally to the north and northwest toward the Dunka River. Extensive marsh occupies the portion of the watershed above and below this sloping area.

6.193 The stream network in the Dunka watershed is similar to the Partridge basin. The Dunka River serves as the main waterway originating in the marshy upper portion of the watershed near the Snowshoe site. The Dunka flows in a northerly direction meandering through extensive marshland. Several similar unnamed tributaries originate in the steeper areas to the east of the Dunka. A major tributary called Langley Creek originates in the marsh which also drains to the Partridge River in the westerly portion of the basin.

6.194 Of significance relative to the Dunka watershed is the fact that it lies to the north of the Laurentian Divide, which separates streams which flow north to Hudson Bay from streams tributary to the St. Lawrence Seaway. Portions of the Dunka watershed are a part of the Laurentian Divide. Because the divide crosses extensive marshland, precise determination of its location is difficult. The Snowshoe site lies in the extreme southern portion of the Dunka watershed approximately along the divide. A small portion of the site may be tributary to the North River.

6.195 A large portion of the Snowshoe site is bog area. This indicates the groundwater levels are at the surface. The groundwater and surface divide run near the southeast limits of the potential basin, with the result that half of the existing groundwater flows in a northwesterly direction and roughly half flows in a southeasterly direction. The permeability of the peat which ranges in thickness from 10 to 20 feet over the site is 10^{-6} to 10^{-4} centimeters per second (.09 to 9 feet per month). The peat, in turn, is underlain by a thin layer of sand and till which is underlain by bedrock which represents an impermeable surface to the groundwater. As a result, the bedrock topography roughly controls the direction of the groundwater flow.

6.196 The Snowshoe site is located at the western portion of a very large senescent peat bog which is the headwaters for the Dunka River and North River. The Dunka River flows into the Kawishiwi River system, and the North River flows into Seven Beaver Lake which is the headwaters of the St. Louis River. There is a series of bog lakes ranging from one-half mile to 5 miles east of the site. The major lake is Sand Lake, about 4 miles east of the site. Lake Culkin is about one-half mile east of the site. To avoid covering Lakes Culkin, Continental, Lobo, and Bonga, the boundary of the Snowshoe site was modified.

6.197 About 2.5 miles of the Dunka River headwaters lies within the Snowshoe site. The available water quality data on the Snowshoe site are on file in the St. Paul District, Corps of Engineers.

6.198 Big Lake and Seven Beaver Lake lie about 3 and 5 miles, respectively, south of the site. These lakes are described in paragraph 6.134-6.135 on pages 111-112.

6.199 About 66 percent of the Snowshoe site is wetlands. There has been no survey made of the flora or fauna on the Snowshoe site. As most of the site is peat bog it can be surmised that most of the site is covered with bog type vegetation. This type habitat is more conducive to fauna species especially adapted to bog conditions. Many wildlife species would not be found in this area due to the lack of food and winter cover. The area is interspersed with some areas of higher ground that could support a more diversified forest and provide some of the food and cover needs that the bog does not provide. The area lies within the major range of the eastern timber wolf.

6.200 The socioeconomic setting is the same as described for the Embarrass alternative. The site is part of the Superior National Forest and 72 percent of the site is owned by the Forest Service. The northern border of the proposed Seven Beaver Recreation area is about one mile south of the Snowshoe site.

6.201 The Snowshoe site has little to offer in the way of fishing opportunities. The area is probably used for some hunting, and there are two State designated recreational trails crossing the site. These include 1 mile of multipurpose trail and 2.5 miles of snowmobile trail.

6.202 There are no known archaeological or historic features within the Snowshoe basin. There are Indian trails skirting the site.

6.203 There are no roads on the Snowshoe site. Forest Route 114 terminates at the northern edge of the site, and a small portion of it could possibly be covered by the tailings.

6.204 The air quality at the site is comparable to that described for the Embarrass and Colvin alternatives.

6.205 Probable Environmental Impacts Associated with Using the Snowshoe Site. The impacts on mineral potential would be the same as those discussed for the Colvin site, above. Use of the Snowshoe site would also eliminate part of a potential peat resource, but it would not significantly alter the commercial potential of the remaining peat resources adjacent ot the site.

6.206 The placement of tailings at this site could potentially load and compress the peat. This could result in a semi-permeable layer, thus reducing soil permeability and seepage from the tailings basin.

6.207 There is a potential for impacts upon the headwaters of two rivers, the Dunka and the North River. The bog that is part of the Snowshoe site is the source of these two streams. It is unknown what impacts the location of a tailings basin in this bog would have on the flows of these two streams or what long-term water quality degradation could result from locating the basin in the headwaters area. This alternative has not been studied in the depth necessary to make this determination.

6.208 The impacts on Lake Superior water quality would be the same as those discussed for the Embarrass alternative.

6.209 About 2.3 miles of the headwaters of the Dunka River would be covered. The aquatic habitats and biota in this area have not been sampled. Table 19, below, compares the probable impacts on aquatic habitat and biota of the Mile Post 7 and Snowshoe plans.

TABLE 19

LOSS OF AQUATIC HABITAT AND BIOTA

IMPACTS	Mile Post 7		Snowshoe	
Loss of Aquatic Habitat:				
Streams (Miles)	Big Thirty-Nine Creek	7.0	Dunka River	2.3
	Little Thirty-Nine Creek	2.7		
Lakes (Acres)	None		None	
Marshes (Acres)	800		2,740	
Fish Tolerance	Trout tolerance		Northern pike, walleye, & yellow perch tolerance	

6.210 All vegetation on the site would be destroyed. As the site vegetation has not been surveyed, this impact cannot be qualified.

6.211 The impact on wildlife present on the site would be similar to that discussed for the Mile Post 7 site.

6.212 The socioeconomic impacts of the Snowshoe plan would be similar to those discussed for the Embarrass alternative.

6.213 Implementation of the Snowshoe alternative would necessitate relocation or abandonment of about 2.6 miles of State-designated snowmobile and hiking trails and 16.8 miles of non-State designated trails. This alternative would cause a disruption of the existing Top Township trail system, as about 2.6 miles are contained within the project boundary. This would cause a decrease of about 5 percent of the State-designated trail system in Lake County.

6.214 While not directly taking lands within the proposed Seven Beaver Recreation Area, this alternative could have some adverse impacts upon activity in the park. Should windblown dust become uncontrollable, the recreational experiences at the park would be negatively affected. See paragraphs 6.292-6.293 under the Midway alternative for a discussion of procedures involved in procurement of U.S. Forest Service land.

6.215 While specific site information regarding hunting activity is not available, it is assumed that hunting activity is low due to limited on-site access. However, this alternative would cause a loss of wildlife habitat, about 4,371 acres, and a resultant loss of some hunting activity.

6.216 The visual impacts of the Snowshoe alternative would occur along Forest Route 116-114 along the northwestern corner of the site. Because of the deciduous vegetation in the north portion of the site, more of the dam face would be visible in the winter.

6.217 Since the State of Minnesota public hearings and the development of the concept of disposing of all tailings under water, no new air emission projections have been developed for the Snowshoe site. The table below contains the projected particulate emissions for the original concept of disposal of some coarse tailings above the water level in the basin.

TABLE 20

PROJECTED IMPACT ON TSP LEVELS IN POPULATION CENTERS - WITH MITIGATION

Population Center	Population	Mean Annual TSP Concentration ($\mu g/m^3$): Existing Air Quality	Increases by Phase: Snowshoe C	Increases by Phase: Snowshoe 0-40
Aurora	2,531	40	2	< 1
Babbitt	3,076	45	14	2
Beaver Bay	362	40	2	< 1
Hoyt Lakes	3,634	40	2	< 1
Silver Bay	3,504	30	2	< 1
Tower	699	35	2	< 1

C = initial construction phase; operations phases are indicated by time period in years.

6.218 As with the Embarrass and Colvin plans, the Snowshoe plan would shift the air quality impacts discussed under the Mile Post 7 plan from the North Shore area to the Mesabi Iron Range area.

6.219 Noise level increases would affect 2,700 acres of land during construction with the Snowshoe plan as compared to 630 acres during construction of the Mile Post 7 site. The operations phase would affect 7,000 acres as compared to 3,350 acres for the Mile Post 7 site.

6.220 Tables 21 and 22, below, compare the energy requirements of the Snowshoe and Mile Post 7 alternatives.

TABLE 21

ENERGY REQUIRED FOR CONSTRUCTION OF NEW FACILITIES

	Mile Post 7		Snowshoe	
	Tons	Equivalent BTU's	Tons	Equivalent BTU's
1. Fixed steel	25,080	907×10^9	51,050	$1,846 \times 10^9$
2. Moveable steel	20,600	$1,336 \times 10^9$	37,650	$2,441 \times 10^9$
3. Cement	9,800	75×10^9	11,300	87×10^9
4. Sand	27,200	2×10^9	31,700	3×10^9
5. Gravel	37,000	10×10^9	43,500	12×10^9
6. Lumber	780	3×10^9	2,457	8×10^9
7. Copper	70	4×10^9	250	15×10^9
8. Aluminum	--	--	300	53×10^9
9. Excavation	7.15×10^6	610×10^9	7.88×10^6	655×10^9
10. Architectural	2,700	128×10^9	4,700	223×10^9
TOTAL EQUIVALENT BTU'S		$3,075 \times 10^9$		$5,343 \times 10^9$

TABLE 22

ANNUAL ENERGY REQUIREMENTS FOR RESERVE MINING TACONITE OPERATIONS (EQUIVALENT BTU'S)

Category	Mile Post 7	Snowshoe
1. Operation of facilities	$20,788 \times 10^9$	$22,766 \times 10^9$
2. Transportation of materials	843×10^9	498×10^9
3. Transportation of personnel	--	10×10^9
4. Construction of new facilities*	77×10^9	134×10^9

TABLE 22 (cont.)

Category	Mile Post 7	Snowshoe
5. Total energy requirements	21,708 x 10^9	23,408 x 10^9
6. Energy required per long ton of taconite pellets produced	2,285,053	2,187,644
7. Energy per long ton of pellets for tailing distribution, process steam, transmission loss, and make-up water pumping	1,500	189,220
8. Total energy per long ton of pellets	2,286,553	2,376,864

* Construction energy costs pro rated over 40-year project life to obtain annual energy costs.

6.221 The Snowshoe alternative would require more total energy and more energy per unit of product than the Mile Post 7 plan. Reserve could produce 10.7 million tons of pellets per year under the Snowshoe plan but only 9.5 million tons per year under the Mile Post 7 plan.

6.222 Due to the lack of complete information on the Snowshoe site it is difficult to make a comparison as to the merits of using the Snowshoe or Mile Post 7 site. The advantages to Reserve in using the Mile Post 7 site are the same as those discussed in the comparisons with the Embarrass and Colvin sites.

6.223 From the information available, it appears that it would be environmentally advantageous to use the Snowshoe site instead of the Mile Post 7 site for the following primary reasons:

a. There appears to be less potential for water quality degradation with the Snowshoe site.

b. There would be less aquatic habitat lost with the Snowshoe site.

c. The terrestrial habitat that would be lost with the Snowshoe site appears to be of lower quality than the Mile Post 7 habitat.

Midway (Mile Post 20) Site

6.224 The Midway site is the alternative preferred by the DNR and the MPCA. The site would be located adjacent to Reserve's railroad approximately 20 rail miles from Silver Bay (exhibit 53).

6.225 Facilities and Operation. The Midway alternative would have the following aspects in common with the Mile Post 7 proposal: mining coarse crushing, rail haulage of coarse crushed ore, fine crushing, dry cobbing, concentrating, concentrate filtering, and tailings separation and filtering.

6.226 The coarse tailings and fine tailings would be transported to the Midway basin by the same general method as proposed in the Mile Post 7 plan. Coarse (cobbed and filtered) tailings would be conveyed across U.S. Highway 61 to loading facilities and then rail hauled to the proposed Midway disposal area. The conveyor system would cross U.S. Highway 61 northeast of the concentrating plant. The railroad load-out facilities would be adjacent to Reserve's existing railroad. The coarse tailings would be hauled on Reserve's existing railroad; however, new trackage would be required at the Silver Bay yard and at the Midway site.

6.227 Fine tailings and fly ash would be pumped as a 60-percent (by weight) slurry through a double pipeline to the Midway tailings disposal area. The pipe would have a 24-inch outside diameter. The pipeline length would follow the existing Reserve railroad and have a length of approximately 118,000 feet and rise 1,370 feet above Lake Superior. Seven pump houses would be required. The slurry would contain 4 long tons per hour (LTPH) of fly ash from the Silver Bay power plant along with 1,476 LTPH of tailings. A service road would be constructed along the pipeline.

6.228 Process water would be returned from the Midway tailings basin to Silver Bay. The return water pipeline route would be the same as for the tailing pipeline along the existing Reserve railroad.

6.229 Dam Construction. Numerous specific tailings basins have been considered for the Midway site. In July 1974, Barr Engineering examined five basins in the Midway vicinity. In January 1976, they examined a sixth basin (exhibit 59). While any number of basin configurations could be used in the Midway area, this basin configuration was used to formulate the description of the existing conditions and probable impacts of the Midway plan. This potential Midway basin site is located approximately 3 miles northeast of Reserve's railroad junction with the Duluth, Missabe and Iron Range Railroad. This site is in the uppermost region of the Cloquet River watershed which is tributary to the St. Louis River Basin. The basin would include Whyte Creek and would

require the alteration of a portion of Kinney Creek along the western basin limits. For seepage collection this basin area has relatively flat terrain with the highest elevation being about 1,970 feet in the northwestern part of the basin and the lowest elevation being about 1,820 feet in the southern portion of the basin. The soils in the basin essentially are sand and gravel, peat, and gray, sandy, stony till, with most of the dams and inclosed basin resting on glacial outwash consisting of well-sorted sands and gravels. The assumption was made that peat and unsuitable foundation material would be removed as a part of dam construction.

6.230 The tailings basin would be created initially by the construction of a starter dam at the southern basin limits. The starter dam would be constructed of pit-run sand and gravels and a 6-foot blanket of glacial till to reduce seepage loss. Dams constructed of coarse (dry cobbed and filtered) tailings would be required around the entire basin perimeter. These dams would be constructed using the downstream method of dam construction. All dam elevations would provide at least 3 feet of freeboard above the pond elevation caused by the probable maximum precipitation.

6.231 Seepage Collection System and Stream Diversion. Available soils data in the vicinity of possible tailings basins in the Midway area indicate that outwash sands and gravels are the dominant underlying soil type. Therefore, seepage from basins in the Midway area could be significant. As at the Mile Post 7 site, seepage through the dams and runoff from the downstream dam faces and surrounding areas would be collected and returned to the tailings basin.

6.232 A portion of Kinney Creek along the western limits of the basin would be altered and used as a part of the seepage collection system. A seepage collection ditch along the east and south limits of the basin would minimize seepage into Spring Creek and the Cloquet River. These seepage collection ditches would be directed to a storage area and pumping station near the southwest basin limits. A second seepage collection system and holding pond would accommodate a land-locked area at the northern basin limits. The ultimate uncollected seepage loss is estimated to be 750 gallons per minute.

6.233 Tailings Disposal. Tailings disposal would be generally the same as with the Mile Post 7 proposal. All fine tailings and coarse tailings not used in dam construction would be deposited in the basin and would be covered by water to reduce fugitive dust emissions. A system of splitter dikes as described for the Mile Post 7 site would be used to distribute the tailings throughout the basin.

6.234 Access Roads. Access roads from existing roads in the vicinity of the Midway site would be required. In addition to access using the service road along the pipeline and existing Reserve railroad, access roads to possible new facilities and the tailings basin would be required. For the latest tailings basin site examined, the main access corridor connects the south basin limits to the Forest Service road south of the Cloquet River. Additional access may be desirable from the vicinity of Scott Junction to the west of the basin.

6.235 Utilities. For the Midway proposal the necessary utilities would be similar to those required for the Mile Post 7 plan.

6.236 Environmental Setting. The Midway area is underlain by extrusive volcanic rocks of the North Shore Volcanic Group. Intrusions of mafic intrusive rocks and interbeds of conglomerate and related clastic rocks are included in this grouping.

6.237 The surficial deposits indicate the surface of the bedrock in this area is undulating and is estimated to be at a depth ranging from 40 to 90 feet below the land surface.

6.238 The extrusive Keweenawan lava rocks underlying the Midway area are classified as having remote mineral potential. Some mafic intrusive rocks of the Duluth Gabbro Complex in the vicinity of the site are rated as having a fair mineral potential. No intensive mineral exploration has been carried out in this area because of its low potential, and there is no evidence of known mineralization.

6.239 The soils on the site are predominantly sand and gravel, and sandy glacial till. Peat covers about 30 percent of the site. Most of it lies over glacial outwash with an average depth of 5 to 7 feet. Because of the large supply of peat available in the region, the general economic value of the peat in the potential basin area is low.

6.240 The Midway alternative lies in the uppermost region of the Cloquet River watershed, which is tributary to the St. Louis River, which is in turn tributary to Lake Superior. The Cloquet River watershed is in the eastern portion of the St. Louis watershed, extending in a northeast-southwest direction. The total drainage area at the mouth of the Cloquet River as it joins the St. Louis River is about 792 square miles. The maximum area isolated from the watershed during tailings basin operation would lie in the uppermost regions and amount to about 12.6 square miles.

6.241 The Cloquet River watershed contains extensive swamps and wetlands, probably in the range of 40 to 50 percent. Drainage patterns are relatively well developed in the upper portion of the watershed, in the vicinity of the potential tailings basin site. The watershed contains numerous northeast-southwest trending egg-shaped hills, called drumlins, which create linear drainage patterns with small marshes between them. Morainal hills and ridges generally form the east boundary of the watershed. The east boundary is shared as the upper boundary or divide of the watersheds of numerous streams directly tributary to Lake Superior.

6.242 Stream flow along the lower reaches of the Cloquet River is controlled by four power storage reservoirs owned by Minnesota Power and Light Company. These reservoirs--Boulder Lake, Island Lake, Fish Lake, and Wild Rice Lake--control runoff from more than three-fourths of the watershed. Island Lake reservoir has a normal elevation of about 1370 feet. Cloquet Lake, located just to the east of the potential tailings basin site, has an elevation of about 1917 feet, representing a drop of nearly 500 feet in a distance of about 50 miles. This results in an average drop of about 11 feet per mile.

6.243 There is a possibility that multi-level groundwater tables exist on the Midway site at Mile Post 20; however, no data are available to determine this. The approximate piezometric map at this site shows a groundwater divide north of the potential tailings basin location. In the region of the basin area, the general direction of the groundwater flow is estimated to be to the southwest, moderated locally by collectors such as streams. The area contains some bogs, indicating a water table near the surface. The area under the tailings basin site generally is underlain by sands and gravels with relatively high permeabilities on the order of 10^{-3} to 10^{-2} centimeters per second.

6.244 The area near the Midway alternative contains a wide variety of aquatic habitats including warm water rivers, cold water streams, and warm water lakes. The site is not considered a "lake area" when compared to other regions of Minnesota, but the headwaters of several rivers are found in the area.

6.245 The headwaters of the Cloquet River and its tributaries account for most of the drainage area in the Midway site. These streams depend almost entirely on surface runoff for their water supply. Consequently, extreme fluctuations in water levels are apparent. Water quality of the Cloquet River is suited for the propagation and maintenance of sport fishes. The bog-stained river averages 20 feet wide and 2 feet deep as it flows near the potential disposal site, although a maximum depth of 19 feet has been recorded. Near its mouth, the river is much larger, averaging 115 feet in width and 3 feet in depth. Flow at the mouth averages 643 cubic feet per second while average flow through the Midway site is only 3 cubic feet per second. The Cloquet River headwaters are characterized by numerous boulder-rubble rapids interspersed with spruce bogs and beaver ponds. The bottom is composed primarily of rubble, gravel, and boulders, and there is no silt-induced turbidity. The water quality data available for the Cloquet River are on file with the St. Paul District, Corps of Engineers.

6.246 Benthic invertebrates are vital to the well-being of stream fish populations for they are the primary food source for many fish species. Benthic invertebrates collected from the headwaters of the Cloquet River indicate a fair species diversity but a low level of production; however, samples were taken during July, a time when emergence should be nearing completion.

6.247 Aquatic plants are also an important part of Cloquet River ecology, providing habitat for aquatic insects, hiding areas for fry, organic material to the stream, and food for some fish species. Aquatic macrophytes are not abundant in the Cloquet River, but species diversity is high. A combination of factors such as opaque water and steep banks limit macrophyte production. Emergents such as cattails and bullrushes are limited to exposed mud flats and marshy edges of pools.

6.248 The Cloquet River has been designated a warm water stream and a total of 33 fish species have been collected from the river. Of all the species listed, only brown trout, yellow bullhead (Ictalarus natalis), and brown bullhead (I. nebulosus) have been introduced, and are not considered native to the area. Electro-fishing results from the Cloquet River indicate that it has a catch rate greater than the Minnesota River and nearly equal to the Mississippi and St. Croix Rivers. Redhorse (Moxostoma sp.) and white sucker are the most abundant fish in the river with sunfish (Lepomis sp.), channel catfish (Ictalurus punctatus), northern pike, and walleye being the most abundant game species.

6.249 Several small tributary streams in the disposal site area are classified as cold water streams and thus have the potential to support trout and other cold water fish species. Kinney Creek is a small tributary of the Cloquet River, averaging 12 feet wide and 2 feet deep. At sites sampled there, the bottom was composed entirely of muck and detritus, although some areas of sand and gravel probably occur. Some aquatic vegetation is present in the stream and may be suitable for northern pike spawning. Whyte Creek appears to offer suitable trout habitat. Access to Cloquet River headwaters, Whyte Creek and Kinney Creek is difficult; consequently, fishing pressure is probably light. Brook trout are reportedly taken from Whyte Creek by local anglers. Cloudy Spring Creek is a small cold water tributary of the Cloquet River, averaging 7.5 feet in width and 1 to 8 feet deep. Approximately 40 miles of the creek lie adjacent to the potential seepage collection area. No data on fish population are available, but brook trout are reportedly caught by local fishermen.

6.250 The headwaters region of the Cloquet River is the least productive sector of the entire river. Species diversity is also lowest in this area. Fish inhabiting the Cloquet River near the potential disposal area are exposed to some rigorous environmental conditions. During dry periods, the small feeder streams and even the headwaters of the Cloquet River are intermittent. When stream habitat is reduced during dry periods, fish are crowded together, producing severe conditions such as competition for habitat and food, reduced dissolved oxygen levels and warm temperatures. The shallow nature of the Cloquet River creates the additional problem of winter temperatures freezing all but the deep holes and pools. Once again, competition for space and food would be severe in unfrozen areas.

6.251 One of the most important factors affecting fish species in the Midway site is lack of suitable spawning areas. The shiftable substrate characteristics of the Cloquet River and the clay and muck bottom found in Kinney Creek create generally poor spawning conditions for most species.

6.252 The Midway site is located approximately 3 miles northwest of the headwaters area of the Beaver River and Split Rock River. Both of these rivers, which flow into Lake Superior, are designated trout waters by the Department of Natural Resources. There are also two creeks (Sullivan and Murphy) 2 to 3 miles west of the Midway site that are designated trout streams.

6.253 Within a radius of approximately 5 miles of the proposed Midway site are 12 lakes. Three of these lakes (Cloquet, Katherine, and Sink Lakes) are classified as warm water lakes by the DNR. Sullivan Lake is classified as a cold water lake. The remaining eight (Driller, Phantom, Source, Railroad, Lillian, Kari, Langley and Legler Lakes) are classified as game lakes. A game lake classification indicates there is little winter oxygen in the waters and they are used by waterfowl and furbearers.

6.254 The Midway area provides habitat for the same regional fauna as discussed in Section 2.

6.255 The white-tailed deer and ruffed grouse habitat is quite poor, due to large components of balsam fir and spruce. In relative terms, the habitat is poorer than at the Mile Post 7 site, but the existing habitat at Midway for moose, timber wolf, spruce grouse, fisher, and marten is equal to or better than that found at the Mile Post 7 site. Bear, aquatic furbearer, snowshoe hare and woodcock habitat at the Midway site is comparable to that found at the Mile Post 7 site.

6.256 The forest stands in the Midway area are grouped into four general categories. These are northern hardwood, lowland conifer, upland conifer, and deforested types. The northern hardwood type is primarily composed of aspen and birch with some maple and oak (exhibit 60). Approximately 20-25 percent of the Midway site is occupied by this forest type. The lowland conifer type is mainly black spruce and white cedar (Thuja occidentalis) with some tamarack (Larix laricina) and occupies a similar percent of the site as does the northern hardwood type. The upland conifer type occupies the largest portion of the site (roughly 35-40 percent). The upland conifer type is composed primarily of balsam fir (Abies balsarnea) and white spruce with some smaller areas of jackpine, white pine (Pinus strobus), and red pine (P. resinosa). Spruce budworm has greatly damaged the fir and spruce. The deforested type covers the smallest area of the four. It includes brush, farmland, rock outcrops, water, non-productive swamps, roads, and industrial areas.

6.257 The Midway site lies about 17 miles northwest of Silver Bay in an area that is undeveloped. The socioeconomic setting for the Silver Bay area as discussed earlier would be the most applicable when evaluating socioeconomic impacts of the Midway plan.

6.258 The Midway site is within the Superior National Forest and is managed by the U.S. Forest Service under a multiple use - sustained yield program. About 84.3 percent of the 8,680-acre site is in public ownership (exhibit 61). State trust fund lands account for 1,960 acres, Federal lands account for 4,760 acres, and the remaining 1,360 acres are divided among several private owners.

6.259 No known structures or cultural features presently exist on the Midway site, although historical records indicate there were settlers' cabins there at one time.

6.260 White Pine and Sullivan Lake Recreation Areas are 2 and 3 miles, respectively, west of the Midway site. There are no existing or proposed recreation areas in the immediate vicinity of the site.

6.261 The primary recreational use on the Midway site is associated with hiking and snowmobiling. The proposed Mt. Weber snowmobile trail cuts through the northern portion of the area.

6.262 Fishing pressure on the streams in the area is believed to be low due to limited access.

6.263 Access to the Midway site would be via County Road 204, just west of the area, which connects with County Road 2. County Road 2 runs north from Two Harbors and passes just west of the Midway site. The proposed Forest Highway 11 would pass south of the Midway site and provide access from Silver Bay.

6.264 The Reserve Railroad is about 3 miles to the south of the Midway site. The Duluth, Missabe and Iron Range Railroad runs along the western edge of the site.

6.265 There are no air quality monitoring stations in the Midway area. No major sources of air pollution exist near the Midway area.

6.266 The existing noise levels in the vicinity of the Midway site are typical of uninhabited forest areas. The primary non-natural noise sources are occasional recreational vehicles and trains passing on the two nearby railroads.

6.267 Probable Environmental Impacts of Using the Midway Site. The impact on potential mineral resources would be minimal. The soils at the Midway site, except those excavated for dam construction, would be covered by tailings. The productivity of the soils would be destroyed.

6.268 The glacial till soils at the Midway site would allow a much higher seepage rate than at the Mile Post 7 site. This would increase the potential for water quality impact from uncollected seepage into the groundwater.

6.269 The ability of soils at the Midway site to filter fibers is presently unknown. The high seepage rate could contaminate groundwater in the area with fibers.

6.270 Water quality benefits to Lake Superior would be the same as those discussed for the Mile Post 7 site.

6.271 Water quality degradation in area streams would occur in much the same manner as discussed for the proposed Mile Post 7 plan. If a slurry pipeline were used from the site to Silver Bay, the potential for water quality degradation would increase due to the increased threat of pipeline breakage over the added distance.

6.272 The tailings basin would remove 12.6 square miles of the Cloquet River drainage basin, consequently reducing flow downstream. The basin would destroy 5.1 miles of Whyte Creek. The seepage collection system on the west side of the basin would incorporate 1.8 miles of Kinney Creek. The remaining portion of Kinney Creek below the seepage collection system and above the Cloquet River would have its flow reduced. Cloudy Spring Creek is adjacent to the seepage collection system on the east side of the basin, and could possibly be impacted if the seepage collection system leaked or in some other way malfunctioned. Although this area is extremly remote, a malfunction of the collection system would still mean the loss of trout fishing habitat. The removal of the cold water feeder streams also could result in an increase of water temperature for the Cloquet River in those reaches near the disposal site.

6.273 It is unlikely that the lakes within the 5-miles radius of the Midway site would be affected. A possible impact would be fugitive dust reaching these lakes from the disposal site.

6.274 It is not likely that the Midway tailings basin would affect the headwaters of the Beaver or Split Rock Rivers, 3 miles to the southeast. These rivers and their headwaters are in the Lake Superior watershed, while the Midway site is in the St. Louis River watershed. A possible effect may be fugitive dust, as mentioned above for the surrounding lakes.

6.275 Although Sullivan and Murphy Creeks are also in the St. Louis River watershed, their distance from the Midway site suggests they would not likely be affected. There is no contiguous water system connecting them to the site.

6.276 Table 23, below, compares the losses of aquatic habitat for the proposed Mile Post 7 plan and the Midway alternative.

TABLE 23

LOSS OF AQUATIC HABITAT AND BIOTA

IMPACTS	Mile Post 7		Midway	
Loss of Aquatic Habitat:				
Streams (Miles)	Big Thirty-Nine Creek	7.0	Whyte Creek	5.1
	Little Thirty-Nine Creek	2.7	Kinney Creek	1.8
Lake (Acres)	None		None	
Marshes (Acres)	800		689	
Fish Tolerance	Trout tolerance		trout, warm	

6.277 All vegetation on the site would eventually be covered and destroyed. This would result in a loss of 5,326 acres of wildlife habitat. This represents white-tailed deer and ruffed grouse habitat of lesser quality than that which would be lost with the proposed Mile Post 7 plan. The moose, timber wolf, spruce grouse, marten and fisher habitat lost would be of higher quality than that at Mile Post 7. The impacts on the wildlife presently using the site would be the same as discussed for wildlife on the Mile Post 7 site.

6.278 The socioeconomic impacts of the Midway alternative are essentially the same as those for the proposed Mile Post 7 plan with a few minor exceptions. Impacts arising from construction and operation of the tailings basin itself would be somewhat different from those of the Mile Post 7 plan, since the location of the basin is different. Taconite taxes distributable to local units of government would be slightly affected, for the same reason.

6.279 During the construction phase, approximately 1,000 workers would be required to construct the tailings basin, pipeline, and railroad facilities. Since the construction period would be of relatively short duration and since the Midway site is within a reasonable commuting distance from Duluth and the Iron Range (which are the expected labor force centers), no significant socioeconomic impacts beyond those predicted for the proposed Mile Post 7 plan are expected.

6.280 Approximately 25 employees per shift would be required to operate the tailings basin at Midway. Currently, about 25 percent of the work force for the Silver Bay facilities commutes from Two Harbors and Duluth/Superior. Silver Bay and the Midway site are the same distance from these areas, so commuting from these points by the tailings basin employees could be expected. Additionally, since the number of employees required at the basin would be relatively small, commuting by Reserve's railroad from Silver Bay or Babbitt to the Midway site would be a reasonable means of transportation. Since employees working at the Midway site would in all probability commute to and from the Midway site on a daily basis, no significant socioeconomic impacts beyond those identified for the proposed Mile Post 7 plan are expected.

6.281 Under the proposed Mile Post 7 plan, the town of Beaver Bay would receive approximately $13,000, based on the 1975 taconite tax rate, which it currently does not receive. This is due to the location of the proposed Mile Post 7 tailings basin within its boundaries. For the Midway alternative, this tax revenue would go to Silver Creek Township, the location of the Midway site. With this exception, tax distribution for the Midway alternative would be virtually identical to the proposed Mile Post 7 plan tax distribution.

6.282 The recreational use of the Midway site would be lost if the tailings basin were constructed there. This includes the loss of approximately 1.5 miles of a proposed State snowmobile trail. The site would no longer be available for hunting, fishing, and hiking use. The visual impacts of the Midway alternative would occur primarily along County Road 2 and County Road 204 located west of the site. Because of the lack of vegetation cover, the dam would be more visible during the winter.

6.283 The MPCA has conducted an air emission analysis for the Midway site as they have for the Mile Post 7 site. Table 24 contains the emission rates for the various sources. Calculations and projections were made using the same methodoly as described for the Mile Post 7 plan (paragraphs 4.087-4.094 pages 68-72). The only differing factor was that it was determined that with the Midway site, coarse tailings dust would account for 67.5 percent of the fugitive dust emissions as compared to 65.5 percent for the Mile Post 7 plan.

6.284 The MPCA projects that the Midway plan would increase TSP levels at Silver Bay by .15 $\mu g/m^3$ and fiber levels by 32,000 to 99,000 fibers/m^3. As with the Mile Post 7 plan, the TSP emissions would have little or no effect. The fiber levels would amount to approximately one-fourth of those projected for the Mile Post 7 site but would still not meet the standard set by the 8th Circuit Court of Appeals (paragraph 4.098, page 73).

Table 24
Emission Rates for Midway
Operations, Year 0-40

Source Type	Source Extent	Emission Factor	Uncontrolled Emissions (lb/day)	Percent Mitigation	Controlled Emissions (lb/day)
Vehicular Travel					
Dikes and Dams					
Light Duty Vehicles	300-100 veh-mi/day	0.4 lb/veh-mi	120 - 40	50	60 - 20
Heavy Duty Vehicles	50 veh-mi/day	6 lb/veh-mi	300	50	150
Glacial Till					
Light Duty Vehicles	600-800 veh-mi/day	2 lb/veh-mi	1200 - 1600	50	600 - 800
Coarse Tailings Transfer	27,500 tons/day	.07 lb/ton	1925	50	963
Active Exposed Coarse Tailings in Dams and Dikes	441[1] acres	0.25 tons/acre/year	563	50	282

Total Controlled Emission: 2055 - 2215 lb/day

Percent of emissions from tailing sources - 64 - 71

(1) **Assumes average splitter dike width of 200 feet**

6.285 Noise impacts associated with the Midway site would affect 1,650 acres during the construction phase and 6,300 acres during the operating phase. The areas to be impacted by the Mile Post 7 plan are 630 and 3,350 acres, respectively. Neither plan would have noise impacts on any residences.

6.286 Table 25, below, compares the project energy usage for both the Mile Post 7 and the Midway plans.

TABLE 25

ANNUAL ENERGY REQUIREMENTS FOR RESERVE MINING TACONITE OPERATIONS

(Equivalent BTU's)

	Mile Post 7	Midway
1. Operation of facilities	$20,788 \times 10^9$	$20,788 \times 10^9$
2. Transportation of materials	843×10^9	$1,170 \times 10^9$
3. Transportation of personnel	-	NA
4. Construction of new facilities*	77×10^9	77×10^9
5. Total energy requirements	$21,708 \times 10^9$	$22,035 \times 10^9$
6. Energy requirements per long ton of pellets produced	2,285,053	2,319,474
7. Energy per ton of pellets for distribution of tailings	1,500	2,000
8. Total energy per ton of pellets	2,286,553	2,321,474

6.287 The Midway plan would be more expensive in terms of energy consumption, both in total energy consumed and in energy consumed per unit of product produced.

6.288 There would be significant adverse environmental impacts associated with using either the Mile Post 7 site or the Midway site. Using the Midway site would be advantageous over using the Mile Post 7 site for the following salient reasons:

a. Aquatic habitat of lesser quantity and lower quality would be lost with the Midway plan.

b. The Midway plan would have less potential impact upon existing and planneu recreation areas.

6.289 The Mile Post 7 plan is preferred by Reserve because it would require less financial investment.

6.290 The predicted air emissions for the Midway plan would be slightly less for the operations phase and substantially less for the construction phase. This would indicate that of the two sites, the Midway site would be more desirable in the interest of public health.

6.291 The potential for water quality impacts from pipeline breakage and deep seepage would be greater with the Midway alternative.

6.292 Implementation of the Midway plan would take about 18 months longer than the proposed Mile Post 7 plan would take. Part of the Midway site is under Federal ownership as part of the Superior National Forest. The U.S. Forest Service could not sell the land to Reserve, but would have to arrange a land exchange in which Reserve would have to purchase land of equal or greater value to exchange for the Midway lands.

6.293 The basic policy of the Forest Service on land exchanges is to consolidate Federal land. Exchanging the Midway lands would be contrary to this policy as the lands involved are in the center of the Superior National Forest. As can be seen in exhibit 61, there is a "hole" already present at the Midway site in the form of some private lands. A land exhange would enlarge this "hole." A land exchange could also require the preparation of another Federal EIS or a supplement to this document to comply with the mandates of the National Environmental Policy Act of 1969. This could further delay the implementation of the Midway alternative.

6.294 The potential delay resulting from a land exchange also applies to the Babbitt alternatives, especially the Colvin and Snowshoe sites which are 55 percent and 72 percent federally owned, respectively.

6.295 Table 26 below compares the environmental impacts of the Mile Post 7 proposal and the Midway alternative in the areas where there is a difference between the two alternatives.

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Table 26

Comparison of Impacts

	Mile Post 7	Midway
Modification of notable landforms	3 miles of east ridge and a 20-foot waterfall	None
Miles of streams lost	9.7[(1)]	5.1[(2)]
Acres of lake potentially affected	39	0
Acres of wetlands lost	800	689
Uncollected seepage (gpm)	170	750
Ability of soils to filter fibers	Yes	Unknown
Stream diversions	6	1
Pipeline crossings of streams	2	8
Acres of habitat lost through clearing	5,850	5,326
Acres of public land affected	4,420	7,320
Miles of designated hiking and snowmobile trails lost or relocated	12.0	0
Additions to ambient Air quality at Silver Bay: Particulates	.63µg/cu meter	.15µg/cu meter
Fibers per cubic meter	131,000-402,000	32,000-99,000
Energy required per long ton of pellets produced (BTU)	2,286,553	2,321,474
Time from permit granting until operational	3 yrs.	4-6 yrs.[(3)]

(1) Part of this total involves DNR designated trout streams

(2) In addition, 1.8 miles of stream would become part of the seepage collection system.

(3) Time frame is very dependent upon land exchange with U.S. Forest Service.

No Action

6.296 The no action alternative as defined here would be for Reserve Mining to close down operations. This could result from a corporate decision by Reserve's parent companies, or denial of permits for on-land disposal by regulatory agencies, or a combination of the above.

6.297 The no action alternative would halt the discharge of tailings into Lake Superior as would the proposed plan. It is unknown whether the tailings delta would be stabilized, especially if Reserve were dissolved as a corporate entity. It is also difficult to determine whether Reserve would dismantle their Babbitt and Silver Bay facilities.

6.298 A valuable source of domestic iron ore would be taken out of production. At present, Reserve contends that Armco and Republic would purchase needed ore from foreign sources. This in turn would have an adverse impact upon the nation's balance of payments.

6.299 Adverse impacts presently associated with the Reserve operation, such as the discharge of tailings, dispersion of air pollutants, industrial use of water, use of energy, etc., would cease.

6.300 The adverse impacts associated with the no action alternative are primarily socio-economic. Should Reserve Mining Company cease operations in response to disposal permit decisions and no mitigative measures were taken, the social effects at both the individual and the communal system levels would be severe and potentially disabling.

6.301 The most direct individual-level effect of such a company closing would be the loss of jobs for the 3,072 people currently employed by Reserve at Silver Bay and Babbitt, plus the estimated 3,000 "indirect" jobs generated by Reserve (see paragraph 2.018). The abrupt economic loss to these individuals would result in traumatic social disruption and serious personal trouble in each household. The first is a problem of social order, the second a problem of humane consideration.

6.302 The vulnerability of the Lake-Cook-St. Louis county area to closing effects is evident in the fact that 22.8 percent of area employment (excluding Duluth) is in mining. The only other occupational sectors which approach this level are retail trade and professional services, neither of which is a primary industry category. The concentrated proportionate imbalance among primary industry sectors poses strong consequences for the loss of a mining industry and indicates that a massive recovery effort would be needed to restabilize the area's economic system.

6.303 Beyond the direct and aggregated effect upon individuals there are a number of communal social system effects which would result from an abrupt closing. These effects would all arise from the loss of tax revenues to municipal and county budgets; especially to the former. In 1974, municipal expenditures for the city of Babbitt were 57 percent on revenues paid in by Reserve. In the same year over 60 percent of the municipal budget of Silver Bay consisted of Reserve tax monies. The loss of such proportions of municipal budgets would likely result in a sudden incapacity to provide public goods and services which comprise the social overhead costs of the municipal organization of a contemporary American urban place. Specifically, the institutional segments such as education, health care, police, fire protection, transport facilities, recreation, and sanitation, making up a public system, will no longer be supportable. If these collective features of support and order for a geographically concentrated human population fail, the individuals in it must seek them elsewhere and/or disperse for safety. The degree of economic concentration in the primary sector of mining poses a danger and a precarious recovery outlook for such municipalities as Chisolm, Ely, Eveleth, and Hoyt Lakes in addition to Babbitt and Silver Bay.

6.304 It is clear in the present occupational structure and economic mix of the area that the three major impacts of direct employment loss, indirect employment loss, and loss of tax revenues would create crucial career and family life problems for individuals and simultaneously disable the supporting social systems in which people currently live their lives. However, it is unlikely that local American publics would passively endure the development of such consequences. Contingency planning to resist and mitigate harsh outcomes from a company closing are much more probable in the context of the social and political values and styles of American civic culture, in Minnesota, as elsewhere.

6.305 Four major mitigative strategies are immediately apparent as likely public policies which might shape regional and local futures if such a Company closing occurred, regardless of whether such a closing is publicly perceived as a corporate act of economic rationality or an act proceeding from any other corporate motive.

6.306 One mitigative policy which might be developed by State government under Federal provisions and partial funding is that of job re-training and placement assistance.

6.307 A second mitigative approach capable of altering the projected future following a Company closing is that of developing new economic productive capacities to replace mining. Efforts by local and State governments to attract alternative productive components to the regional and local economies might not be an immediate solution but could gradually have a highly beneficial effect. New development could provide a solid and stable economic mix, grounded in diversity, without the single-industry concentration in mining which creates the present vulnerability of many communities to catastrophic impairment.

6.308 A third source of mitigation would be provided to individual job holders through the normal process of unemployment compensation. While this alternative would have the disadvantage of burdening State funds, State unemployment benefits schedules would postpone the complete loss of income to most individuals, providing time for job searches, new employment and/or the restorative effects of public policy measures such as those discussed above. It is possible that unionized employees might also receive benefits from local union funds.

7.000 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE HUMAN ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

7.001 The proposed heated water discharge system and the proposed on-land tailings disposal site have a projected use period of 40 years. The discharge from the Lakeside Power Plant would allow the plan to continue to provide power for Reserve's taconite operations and thus is related to the continued exploitation of the taconite resources of the Mesabi Iron Range.

7.002 The discharge of heated water should not detract from the quality of Lake Superior. The high specific heat of water and the volume of Lake Superior would allow the lake waters to absorb the thermal discharge with no impact other than at the point of discharge.

7.003 There would be some loss of biological productivity through the destruction of planktonic organisms as they are entrained in the circulating water. However, their bodies would be returned to the lake and the nutrients tied up in them would be recycled in the lake ecosystem.

7.004 The proposed on-land tailings disposal plan would commit the Mile Post 7 site to industrial use for the next 40 years. The natural productivity of the soil would be lost forever as it would be covered by tailings. All nutrients in the soil would be lost forever.

7.005 All vegetation on the site not cut for pulpwood would be destroyed. Most wildlife on the site would be lost. The biological productivity of the site would be lost for 40 years and would probably never be fully restored to present levels.

7.006 About 10 miles of cold water streams would be permanently destroyed.

7.007 Construction activities could seriously degrade additional cold water streams. There also would be the risk of a tailings spill during operations that could destroy the productivity of these streams.

7.008 There would be degradation of air quality with the proposed plan. Most important here is that the residents of Silver Bay and Beaver Bay would be subjected to higher levels of airborne fibers for a period of 40 years. Based on evidence presented, the Eighth Circuit U.S. Court of Appeals decided that the presence of airborne fibers creates some health risk. Therefore, the proposed project would expose the area residents to a long-term health risk.

7.009 The above described long-term adverse effects on the environment would be imposed for the following benefits to society and the environment. There would be the cessation of the disposal of taconite tailings into Lake Superior. This would be a step forward in reducing the levels of fibers in the lake. The presence of fibers in the waters of Lake Superior has been declared a health risk by the courts. However, while ending the discharge of tailings into the lake would eliminate the main source of the fibers, the fibers already released would still be present in the water. How long they would remain there is unknown. There is also the possibility that fibers would continue to be released into the lake from the tailings already present, but this release would not be as large as when new tailings were being introduced into the lake.

7.010 The proposed delta stabilization plan would be an attempt to prevent or retard the long-term release of fibers into Lake Superior. At the present time the feasibility of this project is uncertain.

7.011 The proposed action would allow Reserve to select the least expensive of the on-land disposal sites, thereby allowing the parent companies to utilize the capital saved in other areas of the economy.

7.012 The proposed plan would allow 450 to 480 Reserve employees to maintain their socioeconomic status and not have their place of employment shifted to an area approximately 40 miles away.

7.013 The plan allows for the continued exploitation of the taconite mineral resources of the Mesabi Iron Range. This iron ore is one of the major sources of domestic iron ore. Reserve would continue to produce 9.5 million tons of taconite pellets for use in the steel industry. This constitutes about 12 percent of American domestic iron ore production, based on 1973 figures. It constitutes about 23 percent of Minnesota's iron ore production.

7.014 Reserve would continue to provide employment to approximately 3,100 people. This also stimulates about 3,000 jobs in service and related employment.

7.015 Reserve would pay an estimated $537 to $559 million in State and local taxes over the 40-year life of the project. Reserve's parent companies would pay an estimated $678 to $770 million in Federal taxes over the 40-year life of the project.

7.016 The continued production of domestic iron ore would help maintain a favorable balance of payments for the United States in the area of foreign trade. The maintenance of domestic production would also ease the nation's vulnerability in the area of essential materials, of which iron ore is a part.

8.000 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

8.001 The materials used to construct the heated water discharge pipe and diffuser would be committed to that use for the life of the power plant. Some of the materials could probably be reused after the life of the project.

8.002 Hydrocarbon fuels and human effort used in the construction and maintenance of the discharge system would be totally committed.

8.003 Approximately 106,000 gpm of Lake Superior water would be committed to power plant cooling for the life of the project.

8.004 An unknown amount of biological productivity would be lost through the destruction of organisms (primarily plankton) passing through the cooling system.

8.005 Approximatley 11,948 x 10^9 BTU's of hydrocarbon fuels would be consumed in the power plant annually.

8.006 Construction of the Mile Post 7 facilities would use 45,680 tons of steel, 74,000 tons of cement, sand and gravel, 780 tons of lumber and 70 tons of copper. The production of this material and construction would use 3,075 x 10^9 BTU's of energy. Human labor would also be expended.

8.007 The biological resources of the disposal site would be destroyed. The productivity of the site would be destroyed for 40 years and would probably never return to present levels.

8.008 About 10 miles of cold water streams would be covered with tailings and destroyed.

8.009 The taconite ore resources of the Peter Mitchell mine would be mined to the fullest extent.

8.010 The operations phase would consume about 21,691 x 10^9 BTU's of energy annually.

8.011 Human labor would continue to be expended in the mining and beneficiation of taconite ore.

8.012 The potential recreational use of the tailings disposal area would be lost for at least 40 years and would probably never be restored to its present capacity.

8.013 The streamflow regime of Big Thirty-Nine, Little Thirty-Nine, and the Beaver River would be permanently altered.

9.000 COORDINATION

9.001 Reserve Mining Company submitted completed applications to the Corps of Engineers for permits for the installation of the heated water discharge structure and construction of the delta stabilization dike on 18 March 1975.

9.002 On 8 April 1975 the Corps of Engineers requested of the State of Minnesota that the Corps be allowed to participate in the formulation of the State environmental impact statement on Reserve's proposed on-land tailings disposal plan as certain portions of Reserve's proposal required Federal permits.

9.003 The Corps of Engineers issued a public notice for the proposed delta stabilization dike on 12 May 1975 and for the proposed heated water discharge system on 14 May 1975.

9.004 On 10 July 1975 the State of Minnesota requested that the Corps of Engineers participate in the formulation of the State draft environmental impact statement (DEIS). During the period June-September 1975, Corps personnel met weekly with State personnel and the State contractors to provide Corps input into the formulation of the State DEIS. The Corps also reviewed and commented on the various rough draft documents used by the State to develop the DEIS. Land use plans as they related to the proposed project were coordinated by the State with the State Planning Agency and appropriate local planning agencies.

9.005 On 25 July 1975 the Corps of Engineers published new regulations in the Federal Register expanding the Corps authority under Section 404 of the Federal Water Pollution Control Act as Amended of 1972. The Corps determined that some of the streams and their adjacent wetlands that are within the proposed Mile Post 7 project area would come under Corps jurisdication as of 1 July 1977.

9.006 On 2 February 1975 Reserve submitted completed applications for 26 separate permits for actions associated with their proposed Mile Post 7 tailings disposal plan. These actions are being processed under File number 76-20-237-000-02.

9.007 The Corps of Engineers issued a public notice on the proposed Mile Post 7 plan on 19 March 1976.

9.008 The public notices for the proposed delta stabilization project and heated water discharge system were forwarded to the Minnesota State Historic Preservation Officer (SHPO) and the Minnesota State Archaeologist. Mr. Fridley, SHPO, responded requesting a survey of Beaver Island be made prior to the issuance of a permit for the discharge system (exhibit 26).

9.009 Both the SHPO and the State Archaeologist have indicated the need for a survey of the Mile Post 7 site in the State of Minnesota draft environmental impact statement.

9.010 On 10 December 1976 Reserve submitted revised permit applications based on design changes in the proposed project (see section 1). Public notice of the revised proposal has not yet been issued.

9.011 As required under Section 404(b) of Public Law 92-500, the Corps of Engineers has conducted an evaluation of the proposed project. This 404(b) evaluation is contained in exhibit 62.

9.012 Public hearings will be held subsequent to the 7 April 1977 arguments before the Minnesota Supreme Court.

9.013 The following agencies, interest groups, and individuals were funished copies of the draft environmental impact statement for review and comment.

Honorable Robert P. Griffin, U.S. Senator
Honorable Philip A. Hart, U.S. Senator
Honorable Hubert H. Humphrey, U.S. Senator
Honorable Walter F. Mondale, U.S. Senator
Honorable Gaylord Nelson, U.S. Senator
Honorable William S. Proxmire, U.S. Senator
Honorable Joseph Karth, U.S. Representative
Honorable Richard Nolan, U.S. Representative
Honorable James Oberstar, U.S. Representative
Honorable David Obey, U.S. Representative
Honorable Philip E. Ruppe, U.S. Representative
Honorable Patrick J. Lucey, Governor, Wisconsin
Honorable William G. Milliken, Governor, Michigan
Honorable Wendall Anderson, Governor, Minnesota

U.S. Environmental Protection Agency
U.S. Department of Agriculture
U.S. Department of Commerce
U.S. Department of Health, Education, and Welfare
U.S. Department of Housing and Urban Development
U.S. Department of the Interior
U.S. Department of Transportation
Federal Energy Administration
Federal Power Commission
Advisory Council on Historic Preservation

Minnesota Department of Agriculture
Minnesota Department of Business
Minnesota Department of Economic Development
Minnesota Department of Health
Minnesota Highway Department
Minnesota Department of Manpower
Minnesota Department of Natural Resources
Minnesota State Park Commission
Minnesota State Planning Agency
Minnesota Environmental Quality Council
Minnesota Pollution Control Agency
Minnesota Recreation and Park Administration Department
Minnesota Department of Taxation
Minnesota State Archaeologist
Minnesota Dairy and Food Commission
Minnesota Historical Society
Minnesota Indian Affairs Commission
Minnesota Senate Natural Resources and Agriculture Commission
Minnesota State Park Commission
Minnesota Railroad and Warehouse Commission
Michigan Department of Natural Resources
Wisconsin Department of Natural Resources
Minnesota Association of Conservation Education
Minnesota Education Association, Environmental Task Force
Minnesota Environmental Control Citizens Association
Minnesota Environmental Education Council
Minnesota Environmental Education and Research Association
Minnesota Environmental Education Steering Committee
Minnesota Association of Commerce and Industry
Clean Air Clean Water Unlimited
Minnesota Camping Association
Minnesota Conservation Federation
Air Pollution Control Association
Ducks Unlimited
Ecological Society of America, Minnesota Chapter
Environment Information Center, Inc., New York, New York
Environmental Quality Council, Minnesota
Fresh Water Biological Institute
Friends of the Earth
Isaak Walton League of America, Minnesota Division
Lake Agassiz Testing Laboratories
National Audubon Society
The Nature Conservancy
Minnesota Pheasants Unlimited
Minnesota Public Interest Research Group
Sierra Club
Soil Conservation Society of America
Minnesota Waterfowl Association
Wildlife of America

Upper Mississippi River Conservation Committee
Northern Environmental Council
Save Lake Superior Association
Lake Superior and North Shore Association
Minnesota Land Use Coalition
Minnesota Mycological Society
University of Minnesota
Department of Anthropology, Bemidji State College
Department of Anthropology, St. Cloud State College
Department of Anthropology, Macalester College
Environmental Concern Organization, Hamline University
Institute for Ecological Studies, Grand Forks, North Dakota
Institute for Environmental Studies, University of Wisconsin
Minnesota Regional Development Commission
Minnesota Resources Commission
Minnesota Water Resource Board
Minnesota Association of Watershed Districts
Department of Iron Range Resource and Rehabilitation
Legislative Commission on Minnesota Resources
Arrowhead Regional Development Commission
Upper Mississippi River Basin Commission
Governor's Trail Advisory Commission
Great Lakes Basin Commission
Head of the Lakes Council of Governments
Upper Great Lakes Regional Commission
Minnesota-Wisconsin Boundary Area Commission
Wisconsin Department of Natural Resources
Superior Harbor Commission
Seaway Port Authority of Duluth

U.S. Steel Corporation
Reserve Mining Company
Kemberlands, Ltd.
Northern Land Company
Duluth, Missabe and Iron Range Railroad Company, Duluth
Honorable Robert Beaudin, Mayor, City of Duluth
Honorable Charles C. Deneweth, Mayor, City of Superior
Duluth Chamber of Commerce
Roman Catholic Diocese of Duluth
Seaway Port Authority of Duluth
Superior Harbor Commission

Lake County Auditor
Lake County Board of Commissioners
Lake County Planning and Advisory Committee
Lake County Planning and Zoning Commission

Honorable Melvin W. Koepke, Mayor, Silver Bay
Delbert Rieke, Engineer, Silver Bay
Barton-Ashman Associates, Inc.
John R. Behnke
Leslie Bowman
Robert J. Hall

John M. Jacobsen
Glenn W. Oulie
Florence Keockritz
Rodney R. Nelson
Dale Wallace

9.014 Copies of the draft statement were also furnished to the following libraries, to be held as reference material available to the general public for review. Likewise, the final environmental impact statement is being furnished to these libraries.

Environmental Library of Minnesota
1222 Fourth Street SE
Minneapolis, Minnesota

Minneapolis Public Library
Environmental Conservation Library
and Document Division
300 Nicollet Mall
Minneapolis, Minnesota

Duluth Public Library
101 West Second Street
Duluth, Minnesota

Silver Bay Public Library
Silver Bay, Minnesota

Public Library
Two Harbors, Minnesota

Legislative Library
State Capitol
St. Paul, Minnesota

Library, Documents Division
University of Minnesota - Duluth
Dulutn, Minneosta

University of Minnesota
Government Publications Division - M
409 Wilson Library
Minneapolis, Minnesota

University of Minnesota
Agricultural Library
Documents Division
St. Paul Campus
St. Paul, Minnesota

Document Collection
St. Paul Public Library
St. Paul, Minnesota

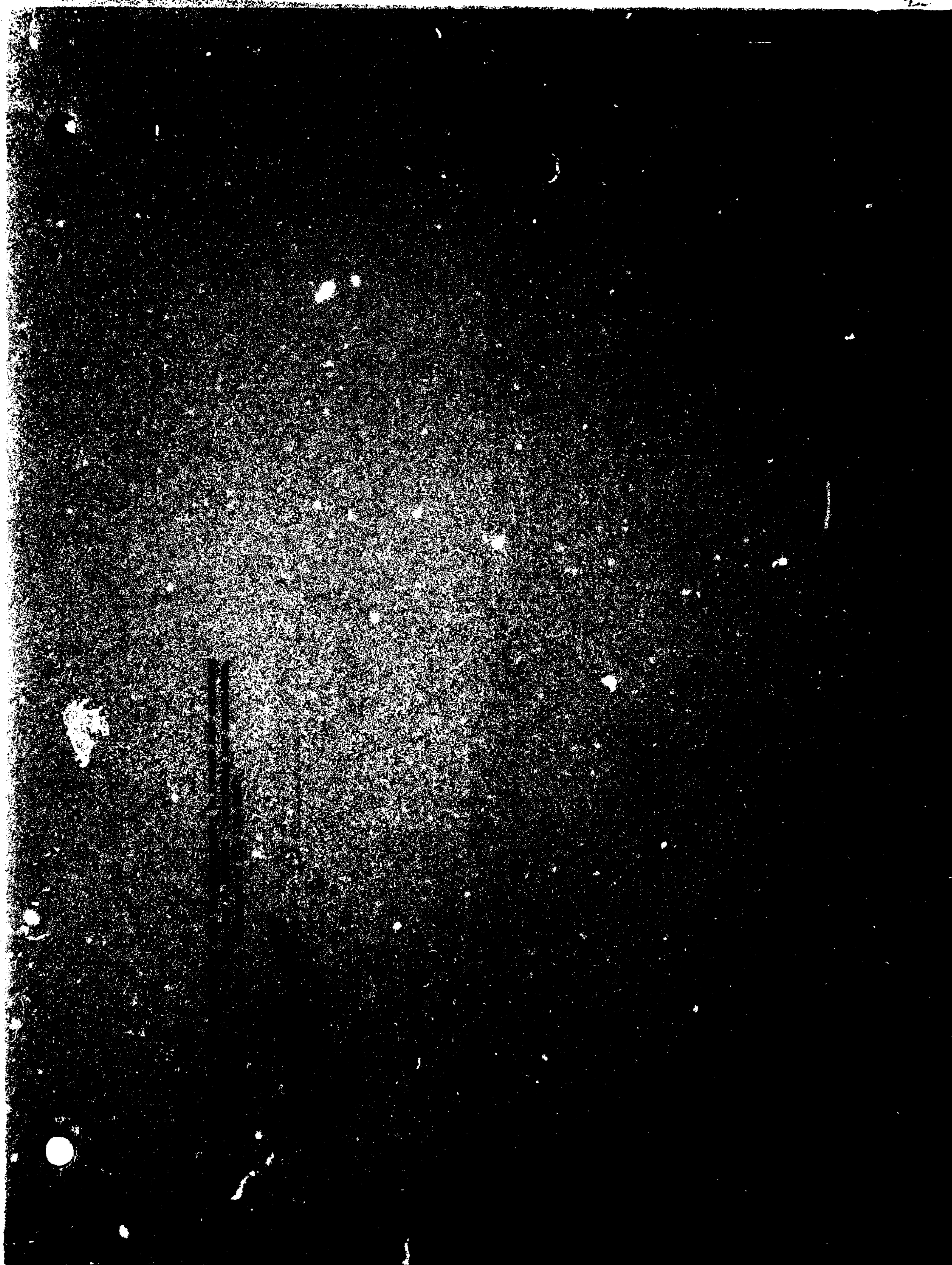
9.015 The following agencies and interest groups commented on the draft environmental impact statement:

U.S. Environmental Protection Agency
U.S. Department of Agriculture Forest Service, Eastern Region
U.S. Department of Agriculture Forest Service, Northeastern Area
U.S. Department of Agriculture Soil Conservation Service
U.S. Department of Commerce
U.S. Department of Health, Education and Welfare
U.S. Department of the Interior
Advisory Council on Historic Preservation

State of Wisconsin Department of Natural Resources
Attorney General, State of Minnesota

Save Lake Superior Association
Reserve Mining Company

9.016 On the ensuing pages are comments we have received on the draft impact statement, along with Corps responses.



9400
May 25, 1976

Corps of Engineers
Custom House

Refer to: NCSED-ER, Draft
Environmental Statement,
Power Plant Discharge Struc-
ture, etc., Silver Bay, MN

... of loss of vegetation
... environmentally sound manner.
... piles, mixing of the
... top layer of the tailings
... roots to

... wetland habitat could perhaps
... is not described in
... and mining
... time for other

... to review this Draft Statement.

35. At the present, ... with soil. They plan ... to form via natural processes.

36. Because of the nature of the ... that wetland habitat ...

[illegible]
[illegible]
[illegible] Lincoln, Nebraska [illegible]

April 12, [illegible]

[illegible]
[illegible]
[illegible]
[illegible]
St. Paul, Minnesota [illegible]

Dear Sir:

Subject: Draft Environmental Impact Statement,
[illegible] Mining Company, Silver Bay, Lake County, Minnesota

[illegible] Harry M. Major, State Conservationist at [illegible] Soil Conservation Service comments [illegible] Environmental Impact Statement. Any comments [illegible] will be furnished to Mr. Major for incorporation [illegible]

[illegible] thank you for the opportunity to review this [illegible]

[illegible]
[illegible]

[illegible] Lincoln, Nebraska
[illegible] St. Paul, Minnesota

[illegible] a significant potential for adverse impacts upon [illegible] of the [illegible] River and the anadromous fishery of that [illegible] River is [illegible] as one of the best steelhead fishing [illegible]. Of the alternatives considered, only [illegible] such a high quality fish resource.

[illegible] TO THE PROPOSED ACTION

[illegible] On-Land Disposal Sites

[illegible] of replacement land for required publicly-owned land [illegible] for each alternative site. The method of compensation [illegible] (such as land exchange, fair market value versus replacement [illegible]) should be discussed.

[illegible] Site

[illegible] Recreation Area is an approved Bureau of [illegible] Service Recreation Planning Composite authorized [illegible] Land and Water Conservation Fund monies. Access roads [illegible] activity would detract from the primitive quality of [illegible]. This aspect should be discussed.

[illegible] Site

[illegible] there has been no survey made of the flora or fauna on [illegible] and the environmental setting of the area is described [illegible] the general description, but believe that [illegible] is to be given to the use of this site, ecological [illegible] and opportunity for review be given.

[illegible] vegetation types are associated with all [illegible] Snowshoe. It is suggested [illegible] for all sites.

[illegible] percent of the Midway site. Yet, [illegible] impacts, page 138, the indication [illegible] of peat resources. This seems to [illegible]

[illegible] regarding possible adverse impacts which [illegible] recreation areas.

[illegible] of the Reserve Mining issue, [illegible] is significant.

Corps Responses to the
U. S. Department of the Interior (cont.)

77. We concur that such potential exists, but believe it is [illegible] any long-term damage would occur.

78. The availability of replacement land is not known [illegible] is expected that Reserve could find land to exchange. [illegible] of compensation for Federal land is discussed in paragraph [illegible] 6.294, pages 139-140 for the alternatives [illegible]

79. It was discussed in paragraph 6.162 page 113, of the [illegible] and is discussed in paragraph 6.163 page 113 of the [illegible]

80. This information will not become available as long as [illegible] contends that the Snowshoe site is infeasible. It is not [illegible] to conduct ecological data-gathering surveys of [illegible] public expense on permit applications.

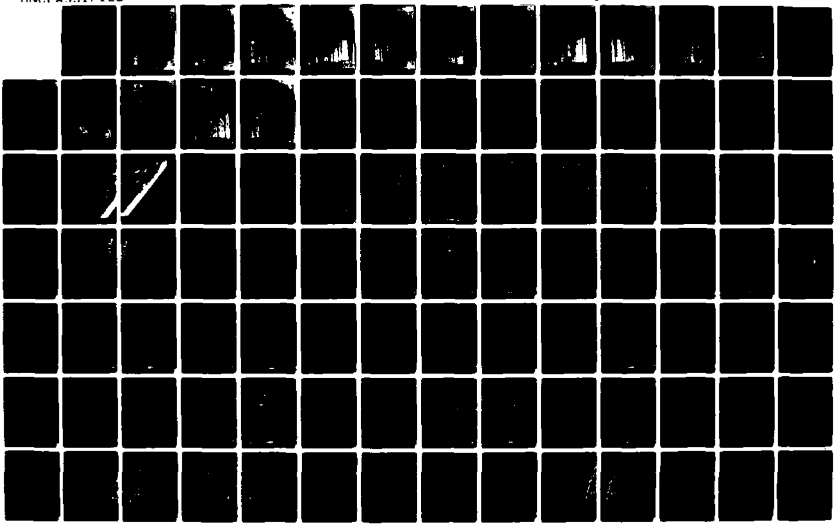
81. This information is not available. See response to [illegible]

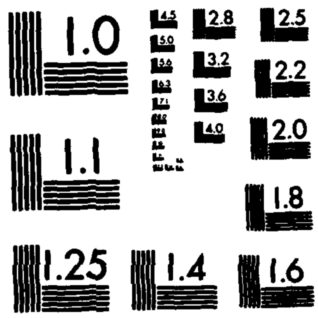
82. The peat deposits at the Midway site are [illegible] the large supply of peat available in the region and the [illegible] economic value of this deposit is of little or no [illegible] peat would be of more value as a bottom seal to the [illegible] site.

83. These recreation areas should not be affected [illegible] cept of covering all tailings with water has been [illegible] windblown dust.

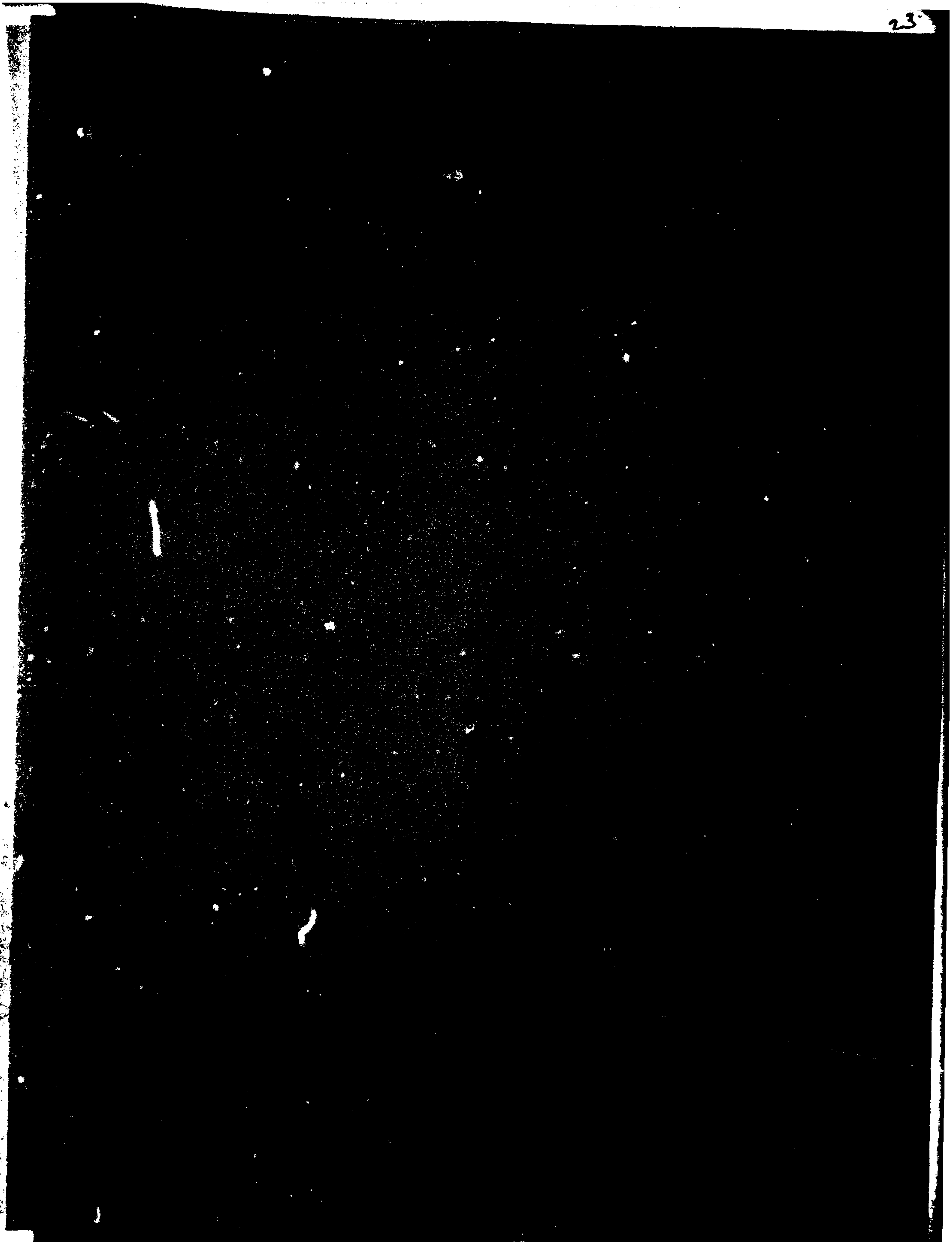
AD-A121 454 POWER PLANT DISCHARGE STRUCTURE DELTA STABILIZATION DIKE AND ON-LAND TACO..(U) CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT MAR 77 3/4

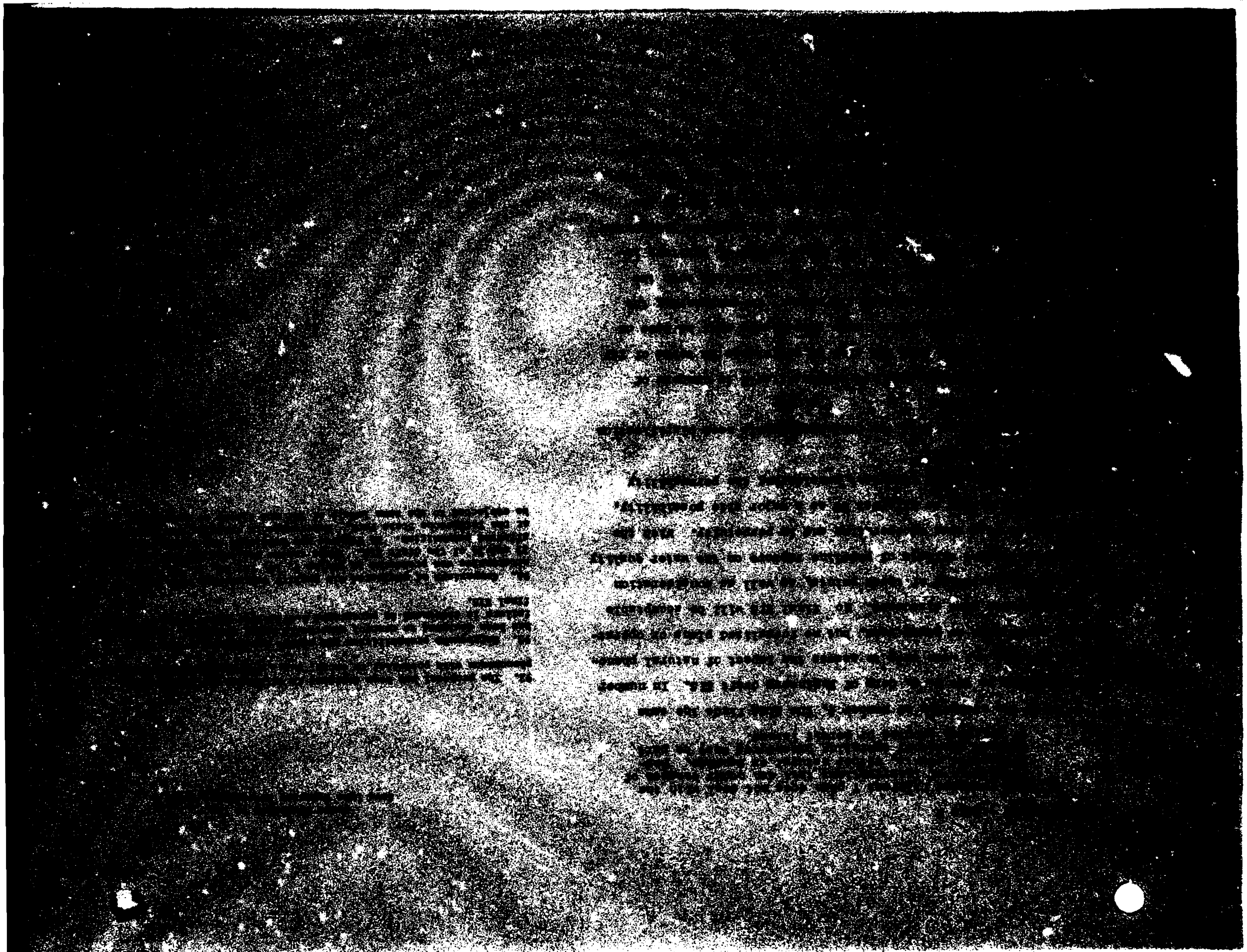
UNCLASSIFIED F/G 13/2 NL

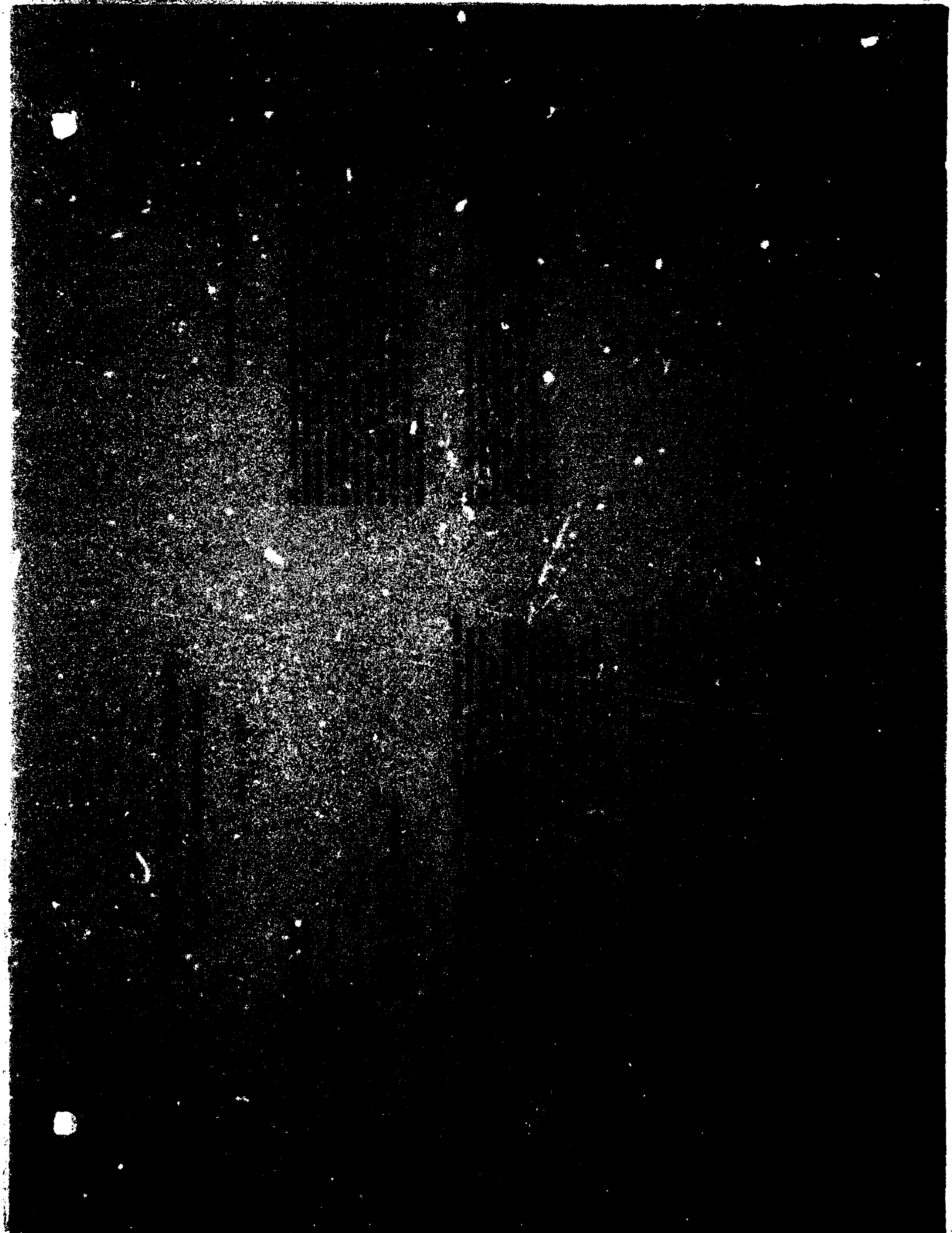




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A







GLOSSARY

Acre-foot	-	43,560 cubic feet.
Ambient	-	Existing or background conditions.
Association	-	A definite or characteristic assemblage of plants living together in an area essentially uniform in environmental conditions; any ecological unit of more than one species.
Beneficiation	-	See paragraph 1.015 for explanation.
Benthic	-	Of the bottoms of lakes or oceans or organisms which live on the bottoms of water bodies.
Biocide	-	Substance toxic to living organisms.
Biota	-	The flora and fauna of a region.
Blowdown	-	The process whereby water high in dissolved solids is removed from the power plant boilers and replaced by water low in dissolved solids to maintain a steady level of concentration and prevent precipitation of the solids.
Bonding	-	A method of borrowing money; selling of bonds to raise money.
Boreal Forest	-	A forest type, consisting largely of white spruce and balsam fir, that extends from Newfoundland to the New England States and westward to Cook Inlet, Alaska; its southern boundary touches the Great Lakes region.
Brake Horsepower	-	The power of an engine or other motor as calculated from the force exerted on a friction brake or absorption dynamometer applied to the flywheel or the shaft.
BTU	-	British thermal units; amount of energy required to raise 1 pound of water 1 degree F.
C Unit	-	100 cubic feet.
Capital Cost	-	Cost of materials and equipment needed for business operation; such as a concentrating plant or rail cars.
Cash Flow	-	Cash on hand available for investment.

Cation	-	A positively charged ion, such as hydrogen, calcium, or aluminum.
cfs	-	Cubic feet per second.
Channel Invert Width	-	Width of the bottom of the channel.
Clastic	-	Rock fragments cemented together to form a coherent rock.
Clear-cut	-	In forestry, to cut out all trees within a logging area.
Conglomerate	-	A rock consisting of rounded pebbles cemented into a coherent rock.
Contingencies	-	Costs that cannot be specifically predicted, such as consulting engineers' fees, administrative costs, etc.
Deciduous	-	Type of trees characterized by leaves that fall off or are actively shed at maturity or at certain seasons.
316(a) Demonstration	-	The proposer of a thermal discharge must demonstrate that the proposed discharge would not significantly affect the aquatic community of the receiving water before they would receive a permit allowing the thermal discharge.
316(b) Demonstration	-	The operator of a facility such as a power plant must show that the water intake procedure is not harming the aquatic community present or, if it is, that the best available technology is being employed to minimize the adverse effects.
Depletion	-	Tax credit given to mining companies by the Government to compensate them for the dwindling resource base upon which their operation depends.
Detritus	-	A non-dissolved product of disintegration or wearing away; pertains to organic or inorganic matter.
Diatom	-	Unicellular phytoplankton with a siliceous shell.
Direct Operating Costs	-	Actual costs accrued in producing a product.
Diversity	-	The number of kinds of organisms per unit area or volume; the richness of species in a given area.

Evapotranspiration	- Loss of water via evaporation from surfaces and transpiration by plants.
Extrusive	- Igneous rocks which have cooled after reaching the surface.
Fauna	- Animals or plant life; especially the animals or animal life of a region or geological stratum; also, the animals or animal life developed or adapted for living in a specified environment.
Fibers	- Minute crystalline mineral particles having an aspect ratio of 3 to 1 or greater; approximately straight and parallel sides; and under 20 microns in size.
Flocculent	- Chemical additive that causes fine particles to clump together and settle out of a liquid medium.
Flora	- Plant life; especially the plant life characteristic of a region, period, or special environment.
Fly Ash	- Lightweight ash generated by burning coal in power plants.
FOB	- Freight on Board.
FPS	- Feet per second.
Glacial Outwash	- Material deposited by glacial meltwaters.
Grunerite	- A brown silky, fibrous variety of amphibole; $FeSiO_3$.
Hz	- Hertz; a unit of frequency of a periodic process equal to one cycle per second.
Intrusive	- Igneous rock material injected as molten material into older rocks and then solidified under cover of the surrounding rock.
Isotherm	- A line joining points having the same temperature at a given time.
Launder	- Concrete chute.
Launder Bridge	- Bridge with troughs and elevated sides to prevent spillage over the side into the water; instead the spillage is routed to a collection point on the shore.
Loam	- Soil of intermediate texture between sand and clay.
Long Ton	- 2,240 pounds.

Macrophyte	-	Large-bodied aquatic plants, non-microscopic.
Mafic	-	Rock high in ferric mineral content.
MBTU	-	Thousand British Thermal Units.
micron	-	One/one-thousandth of a millimeter. There are about 25,400 microns in an inch.
microgram	-	One/one-millionth of a gram. There are about 28,350,000 micrograms in an ounce.
Mine Waste Rock	-	Rock from the pit either devoid of iron ore or with too small an iron ore content to be usable.
MSL	-	Mean (average) sea level.
Non-Contact Cooling Water	-	Water used in power plant cooling that does not come in contact with any equipment or have chemicals added to it, such that it retains its basic chemical constituency.
NPDES	-	National Pollution Discharge Elimination System permit; i.e., a permit for a point source discharge.
Nutrients	-	Chemical elements necessary for plant growth; most commonly referring to nitrogen and phosphorus in aquatic systems.
Ore	-	As used here, refers to the magnetic taconite that can be stripped, mined, and treated at a profit under existing economic conditions.
Overstory	-	The layer comprised of trees that are 40 or more feet in height in mature stands.
pH	-	A measure of acidity or alkalinity; pH7 is neutral.
Phytoplankton	-	Plant life floating free in water; generally single-celled.
Piezometric Map	-	Map showing the groundwater flow in an area.
Pit-run Sand	-	Sand as found in the ground; not washed to remove non-sand soil and larger rocks.
Pleistocene	-	Epoch lasting from about 2 million years ago until the end of the Wisconsin glacier ($\sim$20,000 years ago).

PreCambrian	-	Rock formed over 600,000 years ago or before the Cambrian age.
Primary Succession	-	Refers to succession which begins on bare, unmodified substrata.
Productive Capacity of Soils	-	A term indicating the depth and composition of a soil.
Pulp	-	A moist, slightly cohering mass consisting of soft, undissolved animal or vegetable matter.
Quench	-	As used here, cooling of hardened taconite pellets.
Raptorial Birds	-	Birds of prey (hawks, falcons, eagles, owls).
Royalties	-	Portion of income Reserve pays to State of Minnesota for mining of the taconite ore.
Splitter Dikes	-	Dikes running across the proposed tailings basin, splitting the pond into cells.
Stenothermal	-	Organisms with a narrow range of temperature tolerance.
Sump	-	Low point of a circulating water system at which the water collects and is pumped to other points where needed.
Taconite Tailings	-	Portion of taconite rock remaining after most of the iron ore is removed; usually this is crushed to sand size or smaller during the process of removing the iron ore.
Thermal Plume	-	Area of water surrounding a thermal discharge where mixing and cooling of the heated discharge is taking place.
Till	-	Non-stratified deposits left by glacial ice.
TSP	-	Total suspended particulates.
Turbidity	-	Cloudiness in water caused by the presence of suspended particles in the water.
µg	-	Microgram.
US GPM	-	United States gallons per minute.
Voids	-	Spaces between individual tailings particles.

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TECHNICAL

APPENDIX

ST. PAUL DISTRICT, CORPS OF ENGINEERS
DEPARTMENT OF THE ARMY

FINAL ENVIRONMENTAL IMPACT STATEMENT
PROPOSED POWER PLANT DISCHARGE STRUCTURE, DELTA STABILIZATION DIKE
AND ON-LAND TACONITE TAILINGS DISPOSAL SITE
RESERVE MINING COMPANY
SILVER BAY, LAKE COUNTY, MINNESOTA

TECHNICAL APPENDIX

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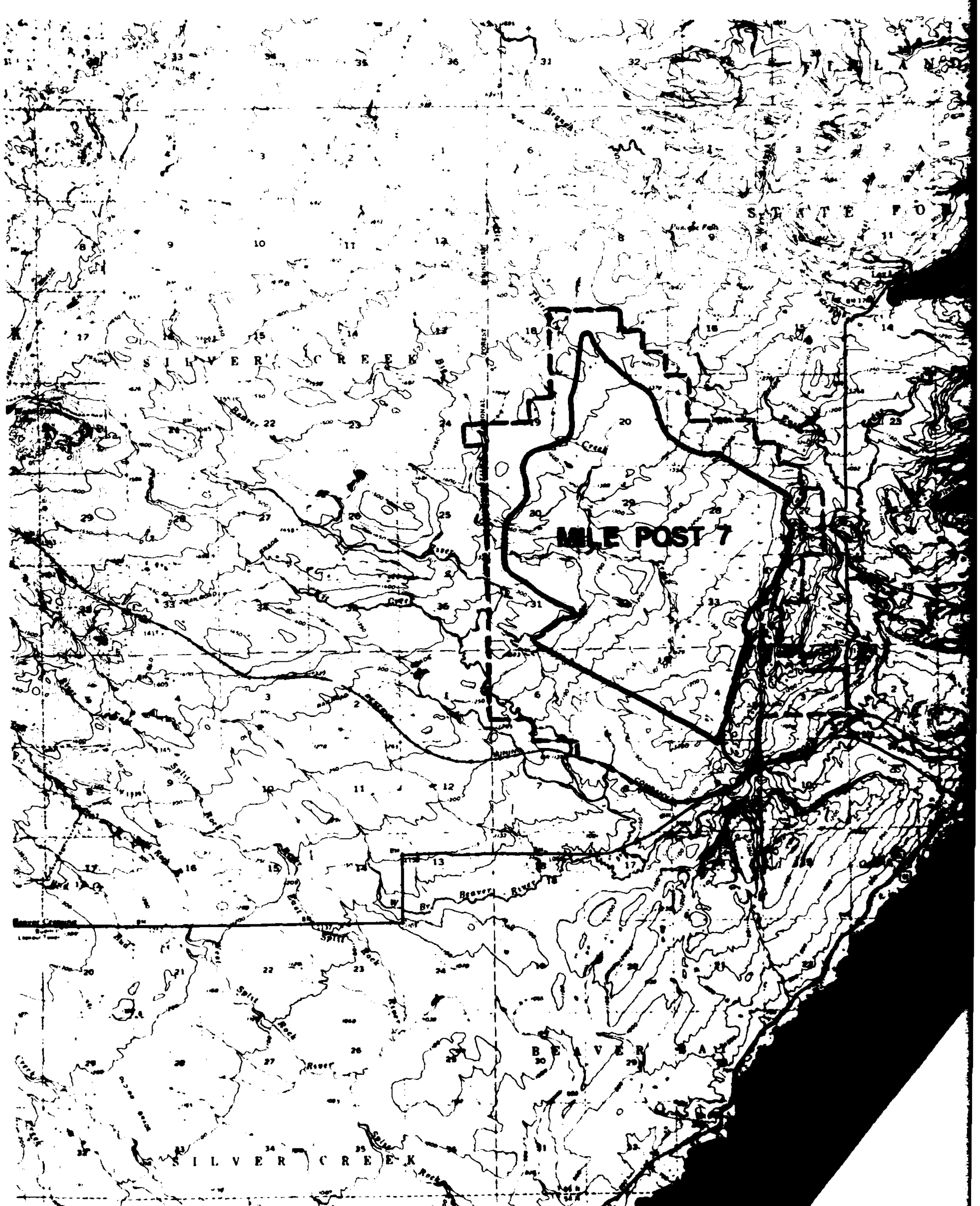

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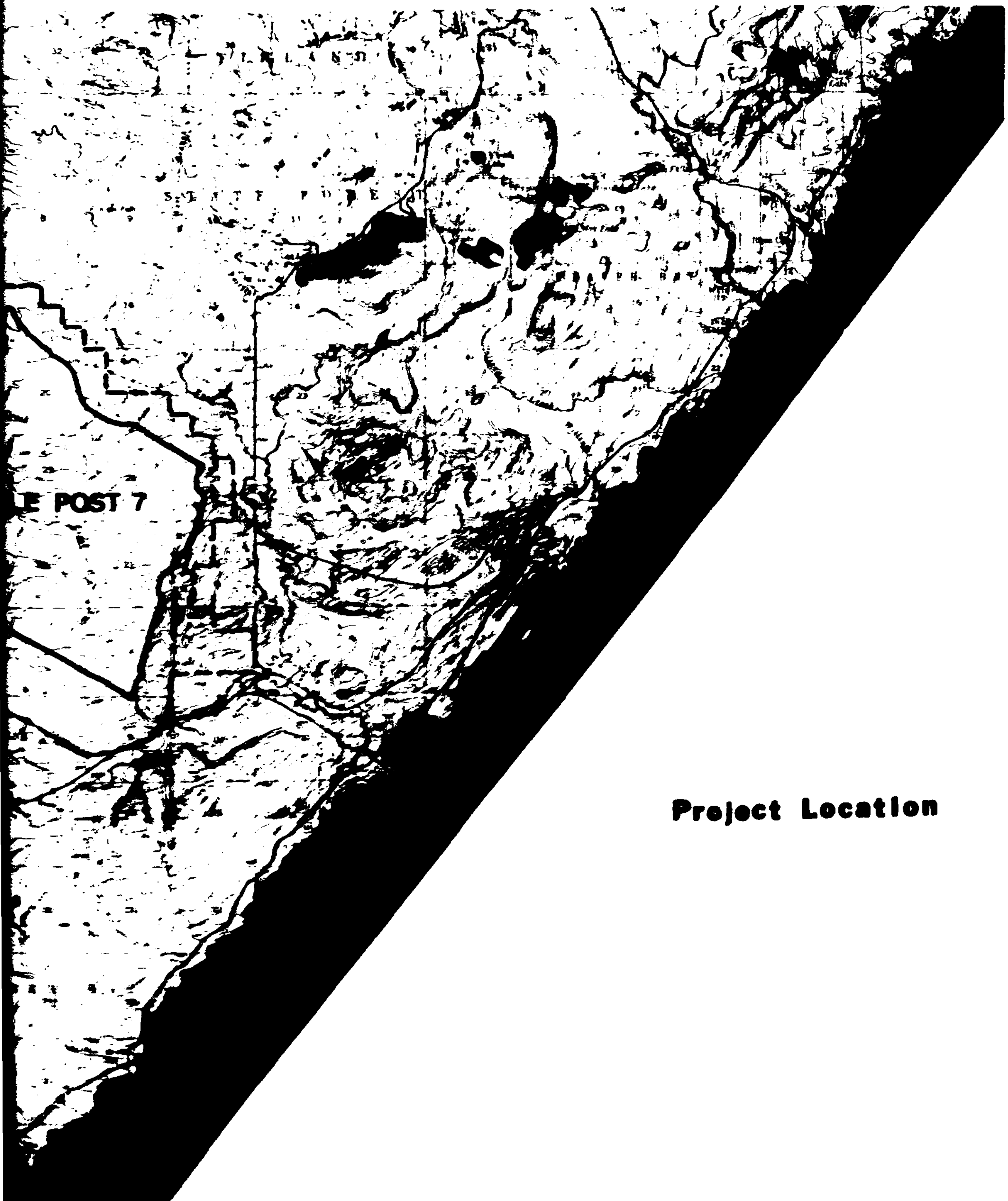


Project Location

Exhibit 1

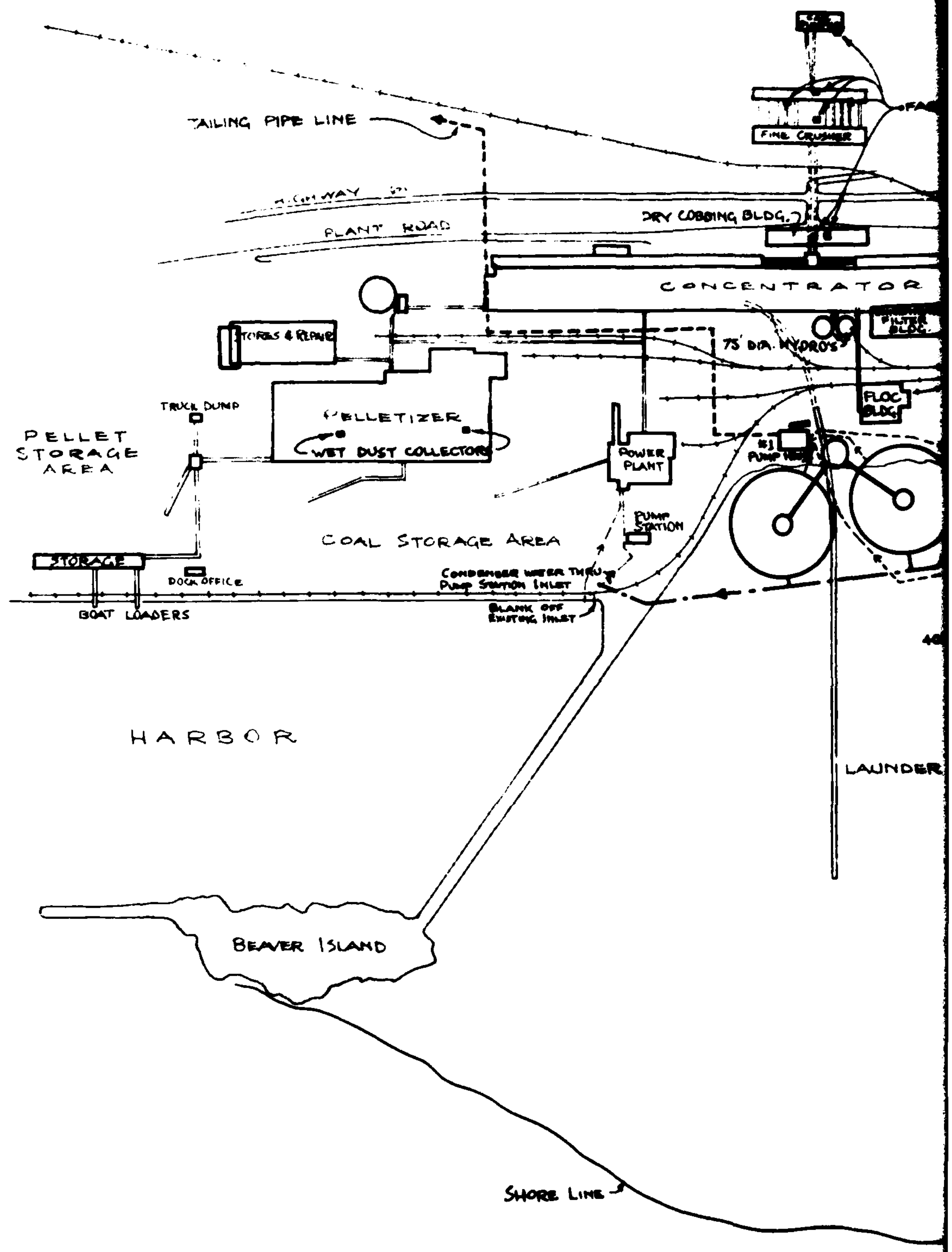
 2

Permits Received for the Discharge of Tailings

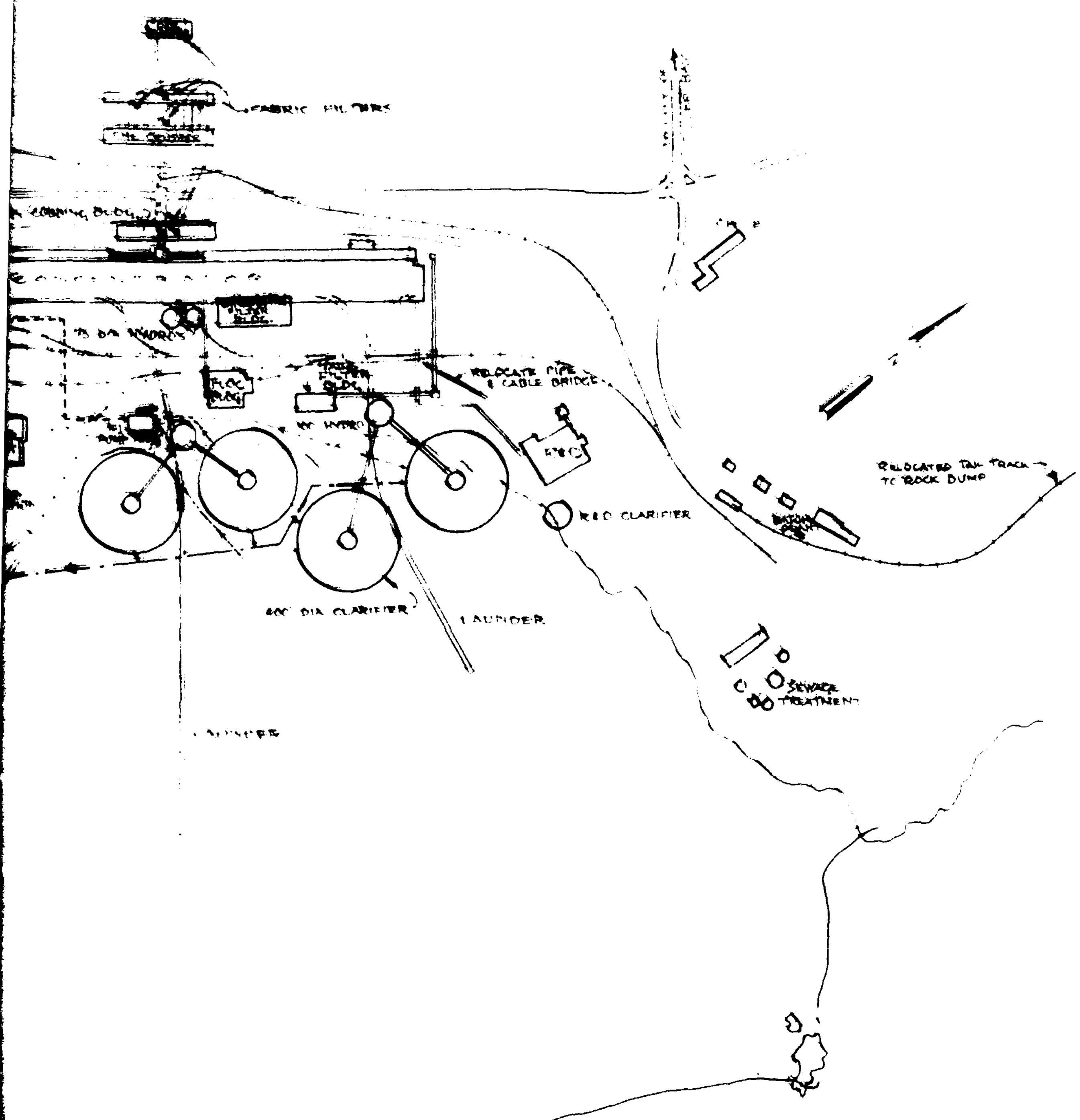
Agency	Permittee	Number or Description	Date
State of Minnesota Dept. of Conservation	Reserve Mining Company	47-12 (796) Permit to appropriate water and return water and tailings to lake	12/13/47
State of Minnesota Water Pollution Control Commission	Reserve Mining Company	Permit to discharge industrial waste	12/22/47
U.S. Dept. of the Army Corps of Engineers	Reserve Mining Company	Dock and harbor construction and tailings deposition	4/22/48
U.S. Dept. of the Army Corps of Engineers	Reserve Mining Company	Amendment	11/30/50
U.S. Dept. of the Army Corps of Engineers	Reserve Mining Company	Amendment	7/23/52
State of Minnesota Dept. of Conservation	Reserve Mining Company	Amendment	7/6/56
State of Minnesota Water Pollution Control Commission	Reserve Mining Company	Amendment	11/12/56
U.S. Dept. of the Army Corps of Engineers	Reserve Mining Company	Amendment	8/12/60
State of Minnesota Water Pollution Control Commission	Reserve Mining Company	Amendment	9/8/60
State of Minnesota Dept. of Conservation	Reserve Mining Company	Amendment	9/29/60
U.S. Dept. of the Army Corps of Engineers	Reserve Mining Company	Amendment	10/11/60
State of Minnesota Pollution Control Agency	University of Minnesota-Mines Experiment Station	#520, Pilot Plant	7/2/65

Exhibit 2

23



TAILING PIPE LINE
PLANT ROAD
FINE CRUSHER
DRY COBBING BLDG.
CONCENTRATOR
FILTER BLDG.
75' DIA. HYDRO'S
FLOC BLDG.
STORES & REPAIR
TRUCK DUMP
PELLETIZER
WET DUST COLLECTOR
PELLET STORAGE AREA
POWER PLANT
PUMP STATION
COAL STORAGE AREA
STORAGE
DOCK OFFICE
BOAT LOADERS
CONDENSER WATER THRU PUMP STATION INLET
BLANK OFF EXISTING INLET
HARBOR
LAUNDER
BEAVER ISLAND
SHORE LINE



PROPOSED PROCESSING PLANT LAYOUT

Exhibit 3

1

2

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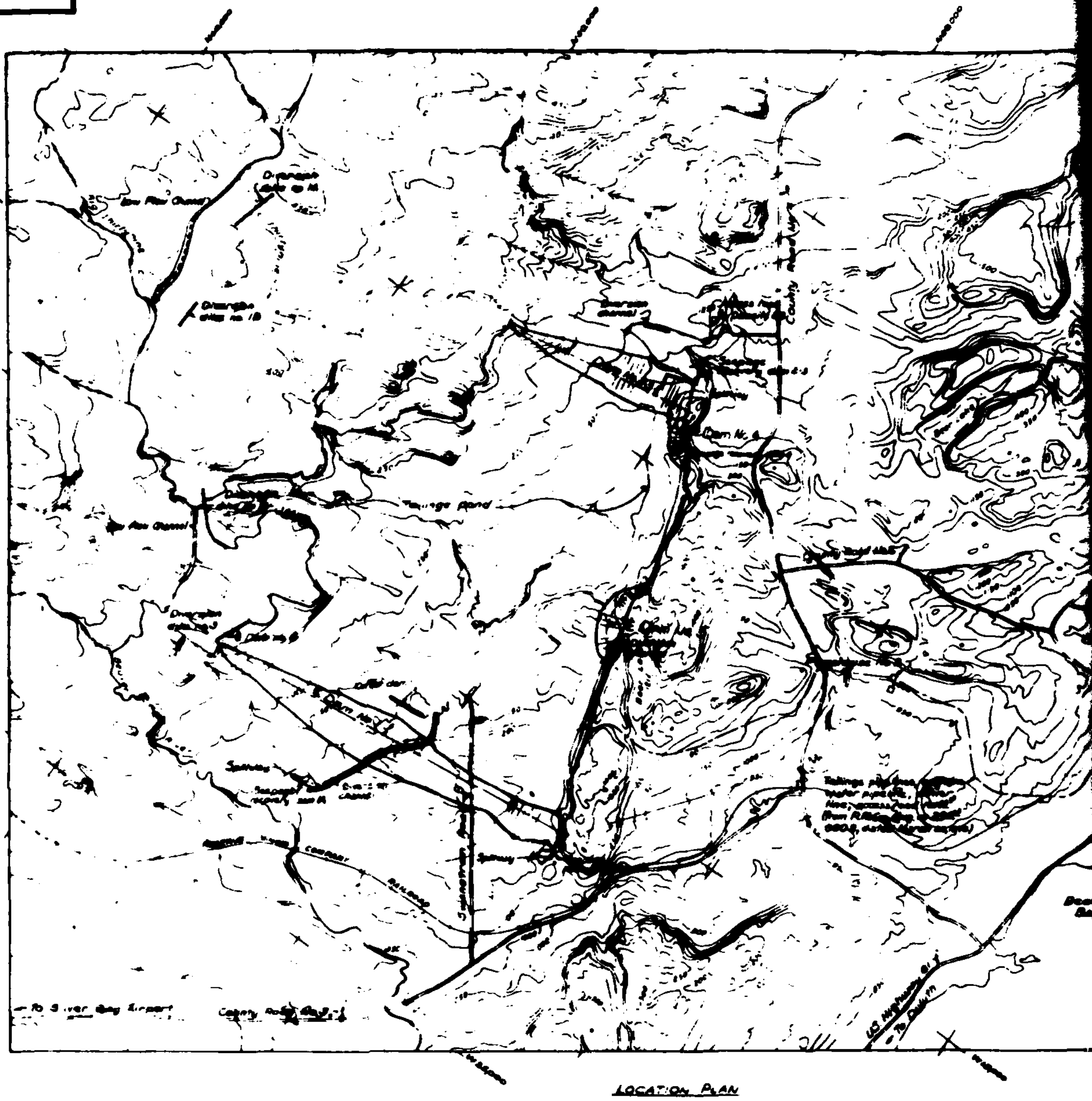


LOCATION PLAN
Scale A

Preliminary - issued to Reserve Mining Company

CONSTRUCTION DRAWINGS

Drawing No.	Drawing Title
292 - 0120	General Layout and Location Plan
292 - 0129	Construction Railway - General Arrangement
292-- 0130	Initial Fine Tailings Discharge Arrangement
292 - 0131	Borrow Pits - Locations and Estimated Volumes
292 - 0132	Clearing Limits
292 - 0133	Tailings Pond - Extent with Time
292 - 0140	Tentative Construction Schedule
292 - 0160	Tailings Storage Dams - Construction Staging
292 - 0180	Volume Design Curves - Pond Volume, Area and Filling Rates
292 - 0181	Tailings Dams - Construction Volumes
292 - 0200	Damsite No. 1 - General Arrangement
292 - 0201	Damsite No. 1 - Sections and Details
292 - 0202	Damsite No. 1 - Starter Dam and Test Fill
292 - 0203	Damsite No. 1 - Instrumentation
292 - 0204	Damsite No. 1 - Instrumentation Sections
292 - 0205	Damsite No. 1 - Seepage Recovery Dam 1A
292 - 0206	Damsite No. 1 - Seepage Recovery Dam 1B
292 - 0207	Damsite No. 1 - Diversion Channel
292 - 0208	Damsite No. 1 - Grouting Details
292 - 0250	Damsite No. 2-3 - General Arrangement
292 - 0251	Damsite No. 2-3 - Sections and Details
292 - 0252	Damsite No. 2-3 - Starter Dam
292 - 0253	Damsite No. 2-3 - Instrumentation
292 - 0254	Damsite No. 2-3 - Grouting Details
292 - 0255	Damsite No. 2-3 - Seepage Recovery Dam
292 - 0256	Damsite No. 2-3 - Diversion of Seepage Recovery Dam
292 - 0300	Damsite No. 4 - General Arrangement
292 - 0301	Damsite No. 4 - Sections and Details
292 - 0302	Damsite No. 4 - Starter Dam
292 - 0350	Damsite No. 5 - General Arrangement
292 - 0351	Damsite No. 5 - Sections and Details
292 - 0352	Damsite No. 5 - Starter Dam
292 - 0355	Damsite No. 5 - Bear Lake Diversion Details
292 - 0400	Damsite No. 6 - General Arrangement
292 - 0401	Damsite No. 6 - Sections and Details
292 - 0410	Headwaters Diversions - General Arrangement
292 - 0411	Headwaters Diversion No. 1 - General Arrangement
292 - 0412	Headwaters Diversion No. 1 - Sections and Details
292 - 0413	Headwaters Diversion No. 2 - General Arrangement
292 - 0414	Headwaters Diversion No. 2 - Sections

INFORMATION DRAWINGS

Drawing No.	Drawing Title
292 - 0020	Piezometers and Monitoring Wells - Location Plan
292 - 0022	Damsite No. 1 - Test Hole Location Plan
292 - 0023	Damsite No. 2-3 - Test Hole Location Plan
292 - 0024	Geological Plan and Sections
292 - 0025	Geological Cross Sections AA, BB, CC, DD, FF, and [illegible]
292 - 0029	Piezometer Records - Sheet 1
292 - 0031	Damsite No.'s 1 and 2-3 - Contours of Clay Thickness
292 - 0035	Damsite No. 1 Subsoil Profile Section A-A
292 - 0036	Damsite No. 1 Subsoil Profile, Sections B-B, C-C, D-D
292 - 0037	Damsite No. 2-3 Subsoil Profile, Sections A-A, B-B
292 - 0038	Damsite No. 2-3 Subsoil Profile, Section C-C
292 - 0048	Damsite No. 1 Subsoil Profile Sections EE and FF
292 - 0049	Piezometer Records - Sheet 2
292 - 0069	Seepage Recovery Dams - Reservoir Volume Curves and Mass Curves
292 - 0081	Damsite No. 2-3 Subsoil Profile Sections DD and EE
292 - 0071	Hydrologic Design Data
292 - 0072	Embankment and Foundation Materials - Design Parameters
292 - 0073	Damsite No. 1 - Stability Analyses
292 - 0074	Damsite No. 1 - Settlement Predictions
292 - 0075	Damsite No. 1 - Seepage Flow Nets
292 - 0076	Damsites No.'s 1 and 2-3 - Seepage Flow Net Beneath Clay
292 - 0082	Test Hole Location Plan - Diversion No. 1
292 - 0084	Test Hole Location Plan - Diversion No. 2

Scale A

Klohn Leonoff Consultants Ltd.
CIVIL & GEOTECHNICAL ENGINEERS

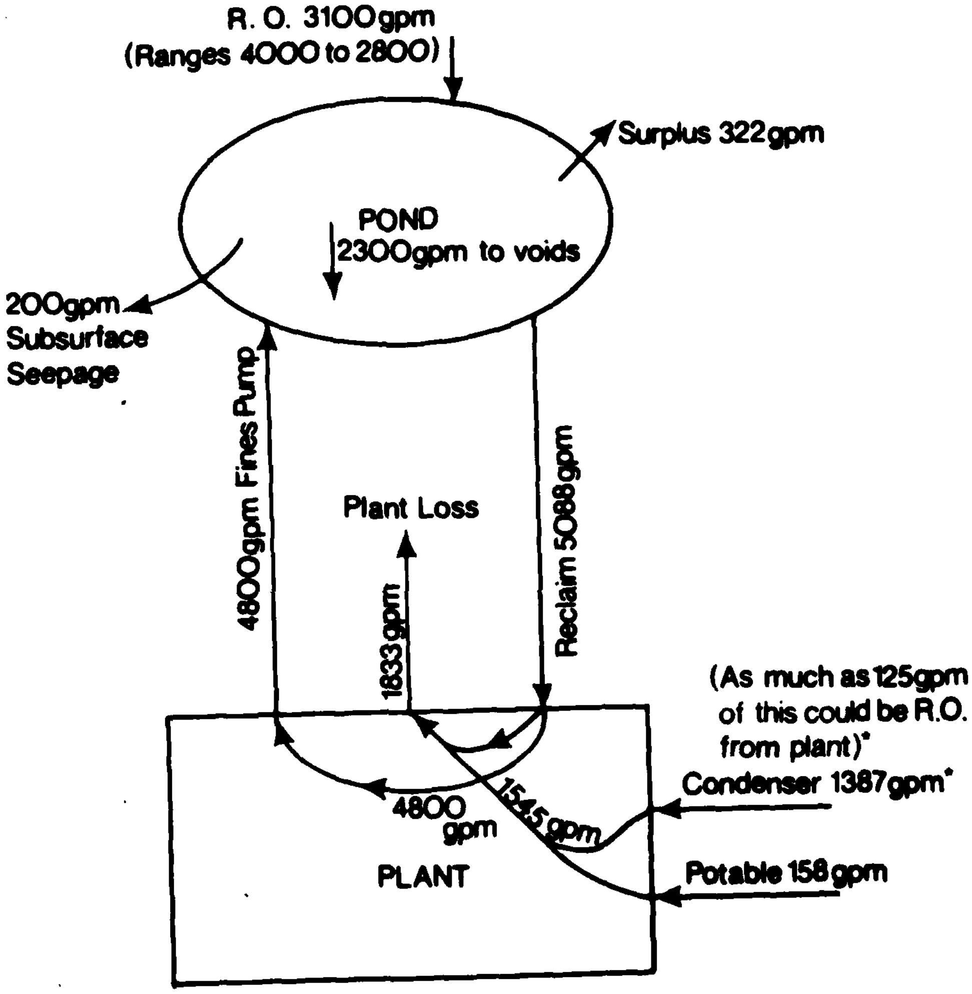
SILVER BAY, MINNESOTA RESERVE MINING COMPANY

MILE POST NO 7 SITE
TAILING DISPOSAL AREA
GENERAL LAYOUT AND LOCATION PLAN

A-4

Exhibit

ESTIMATED PROPOSED PROCESS WATER BALANCE

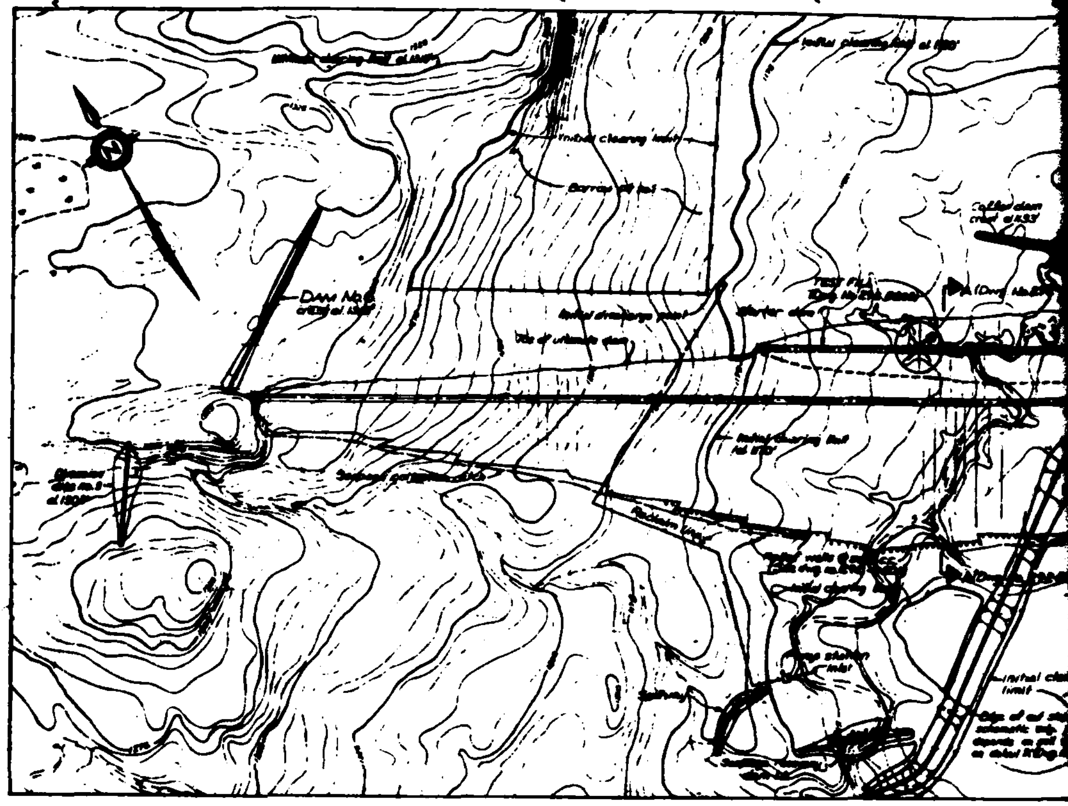


If all condenser water is eliminated, reclaim could be 6475gpm

Exhibit 5

23

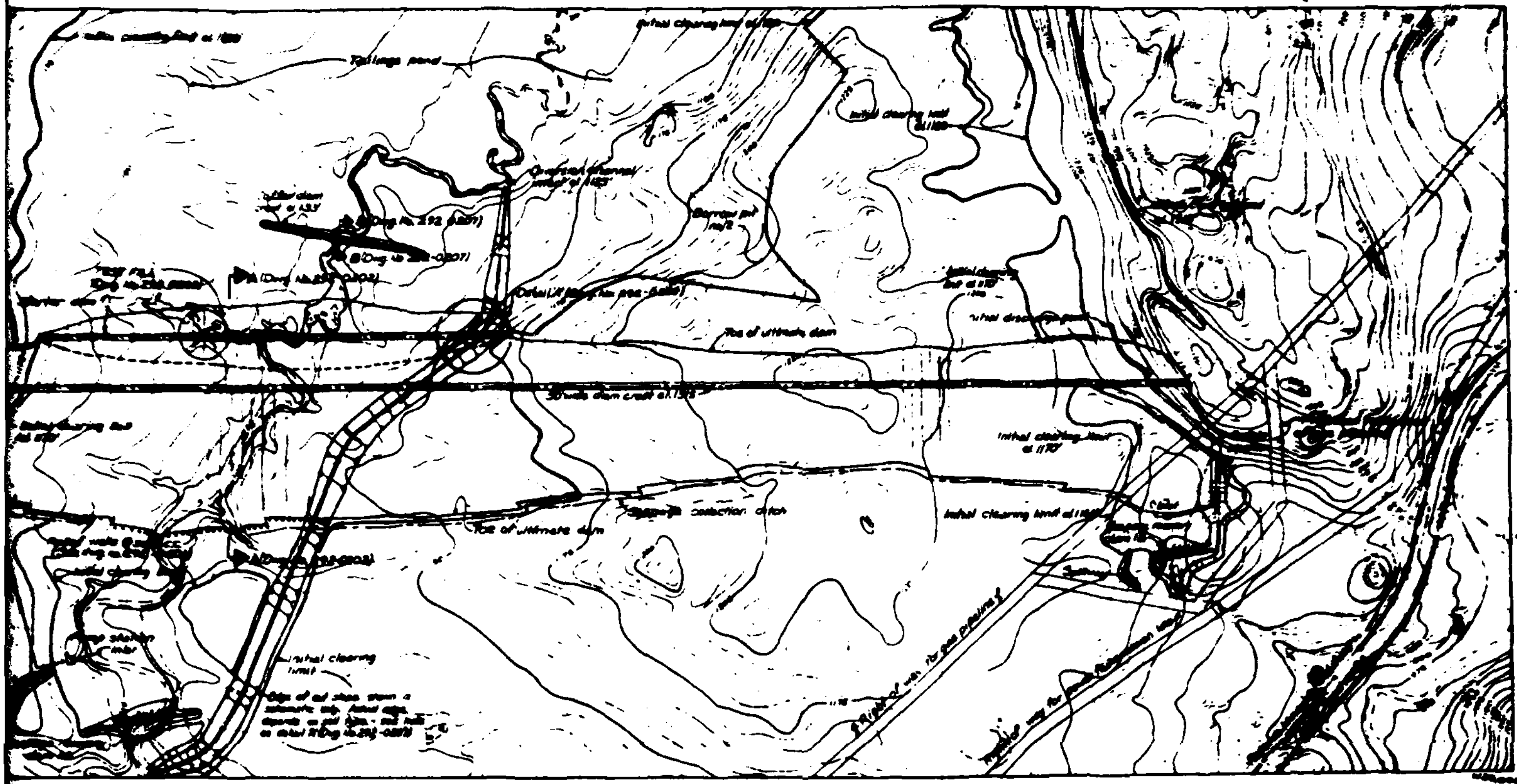
292-0200



No.	Date	Description					
0	[illegible]	Preliminary - Issued to [illegible] Mining Company					
1	[illegible]	Diversion channel relocated					
		[illegible]					
		[illegible]					
		[illegible]					

1

23



LOCATION PLAN
Scale A

NOTES:

1. Pump Station and reclaim pipeline locations are schematic only.
2. Detailed alignment of diversion channel to be determined after survey profile and cross sections completed. Downstream end of diversion channel shown on Drawing No. 292-0207.
3. Following closure of diversion, diversion channel to be backfilled with select excavated material between toe of Dam 1 and a point approximately 500 ft downstream of the downstream toe.
4. Initial clearing limits shown provide sufficient area for construction to month 36.

REFERENCE DRAWINGS:

292-0170	General Layout and Location Plan
292-0201	Damsite No 1 - Sections and Details
292-0202	Damsite No 1 - Starter Dam and Toe Fill
292-0203	Damsite No 1 - Instrumentation
292-0204	Damsite No 1 - Instrumentation - Sections
292-0205	Damsite No 1 - Seepage Recovery Dam 1-A
292-0206	Damsite No 1 - Seepage Recovery Dam 1-B
292-0207	Damsite No 1 - Diversion Channel
292-0208	Damsite No 1 - Grouting Details
292-0400	Damsite No 6 - General Arrangement
292-0401	Damsite No 6 - Sections and Details

Klohn Leonoff Consultants Ltd.

Silver Bay, Minnesota
RESERVE MINING COMPANY

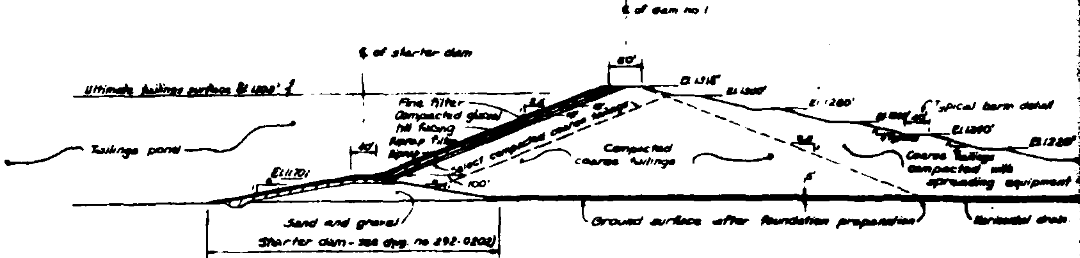
A-6

MILE POST No 7 SITE
TAILING DISPOSAL AREA
DAMSITE No 1
GENERAL ARRANGEMENT

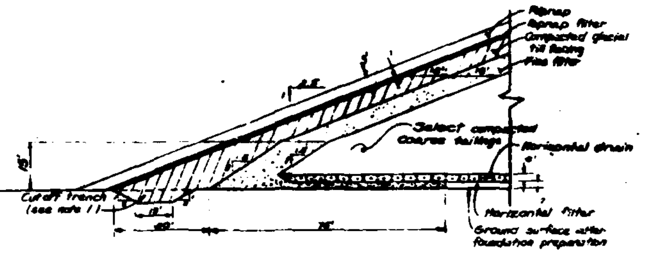
Exhibit

2

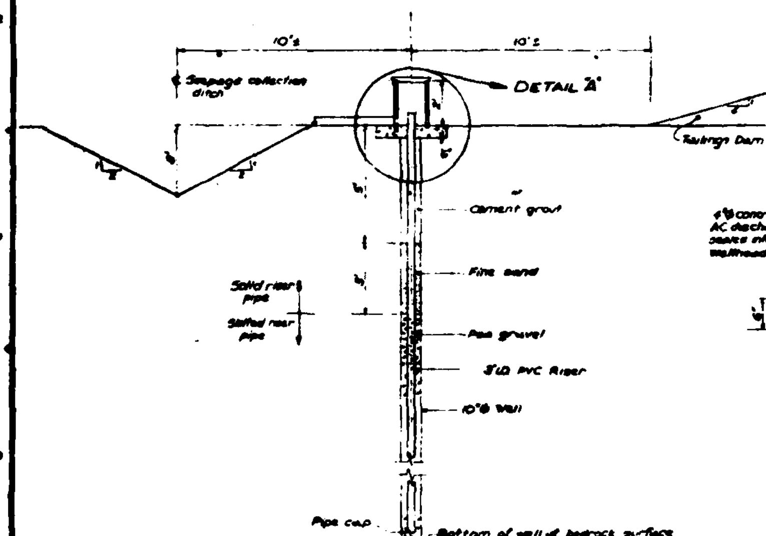
292-0201



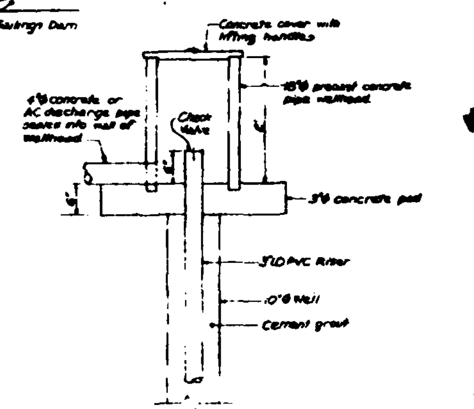
SECTION A-A (Dwg. No. 292-0200)
Scale A



UPSTREAM TOE DETAIL - ABOVE EL.1170
Scale: B

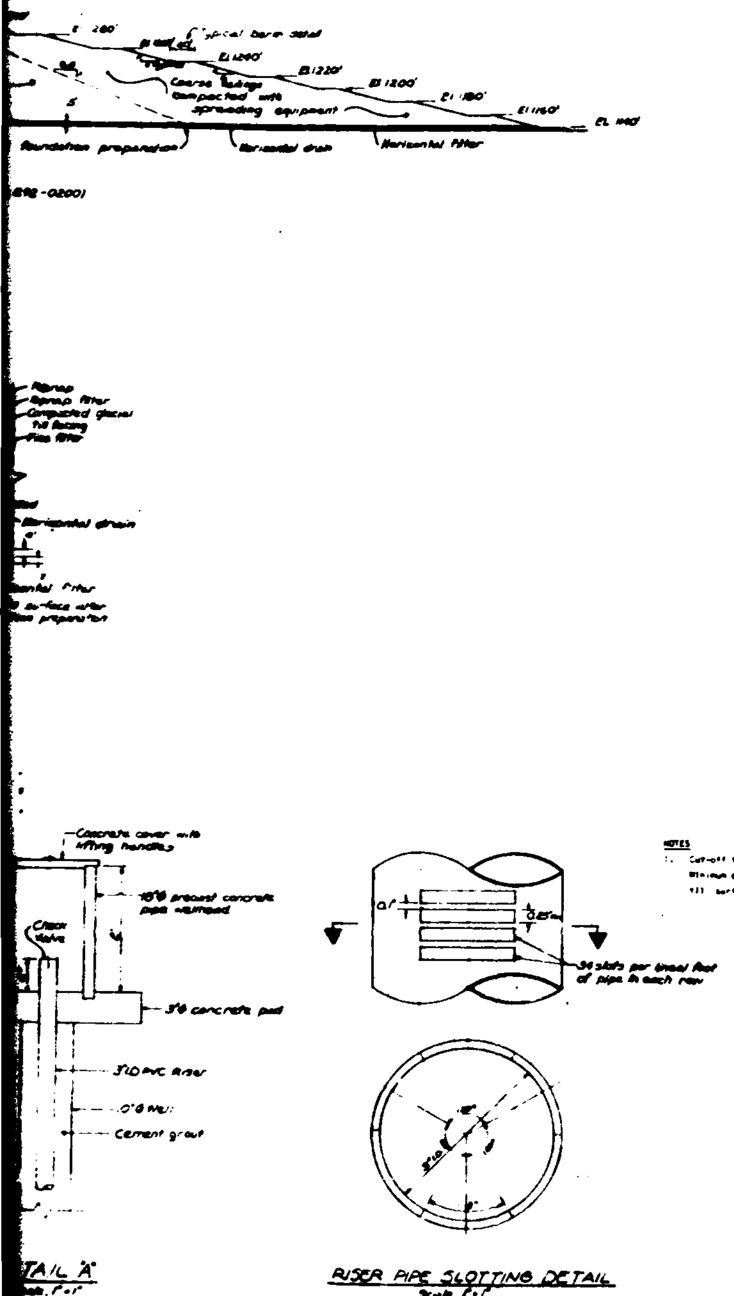


RELIEF WELL DETAIL



DETAIL "A"

–		Preliminary - Issued to Reserve Mining Company
1		Riprap detail: altered, select compacted coarse tailings zone added, relief well detail added.



NOTES

1. Cut-off trench to be excavated into low permeability clay or glacial till. Minimum depth of trench 2 ft. below clay surface or 4 ft. below glacial till surface. Backfill to be compacted glacial till.

REFERENCE DRAWINGS

292-016C	Tailings Storage Dams - Construction Staging
292-020C	Damsite No. 1 - General Arrangement
292-0232	Damsite No. 1 - Starter Dam and Toe Fill

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CIVIL & GEOTECHNICAL ENGINEERS

Silver Bay, Minnesota RESERVE MINING COMPANY

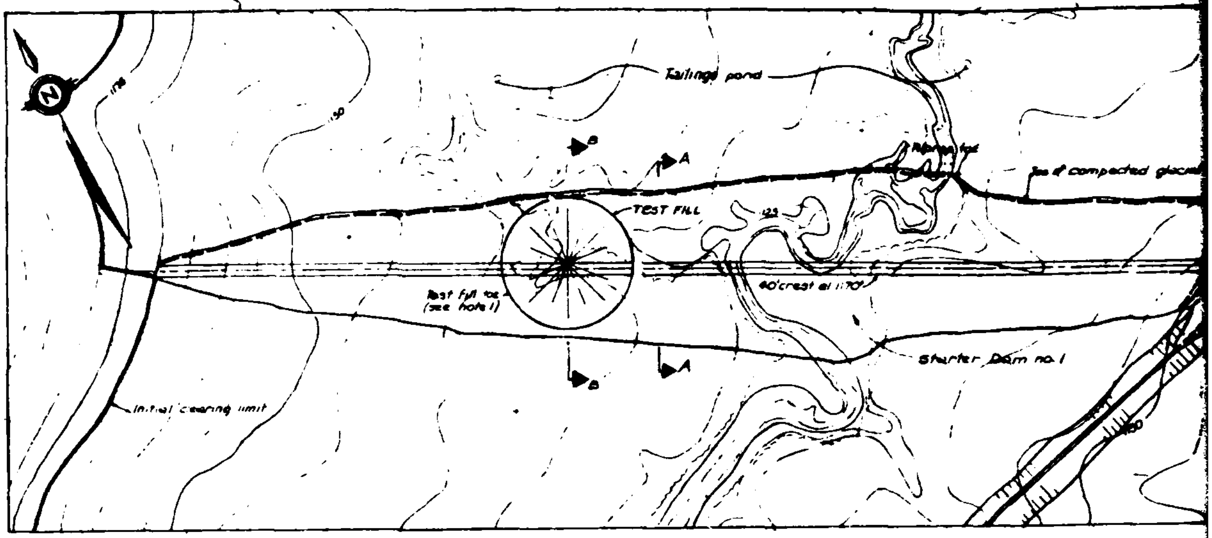
A-7

Mile Post No 7 Site
Tailings Disposal Area
Damsite No 1
Sections and Details

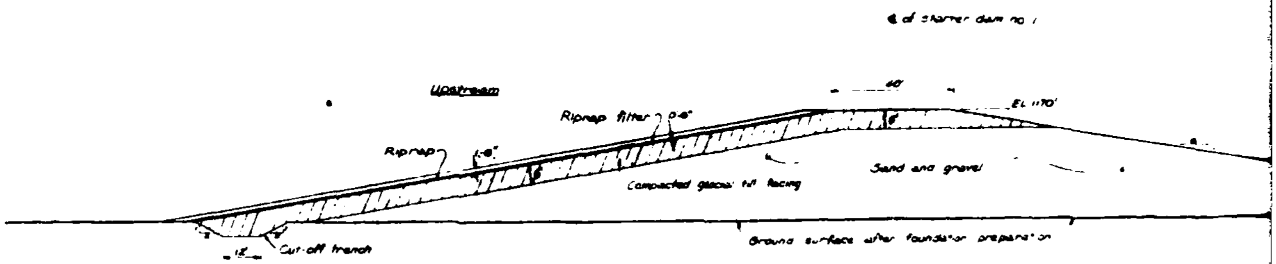
Exhibit

Revision 1

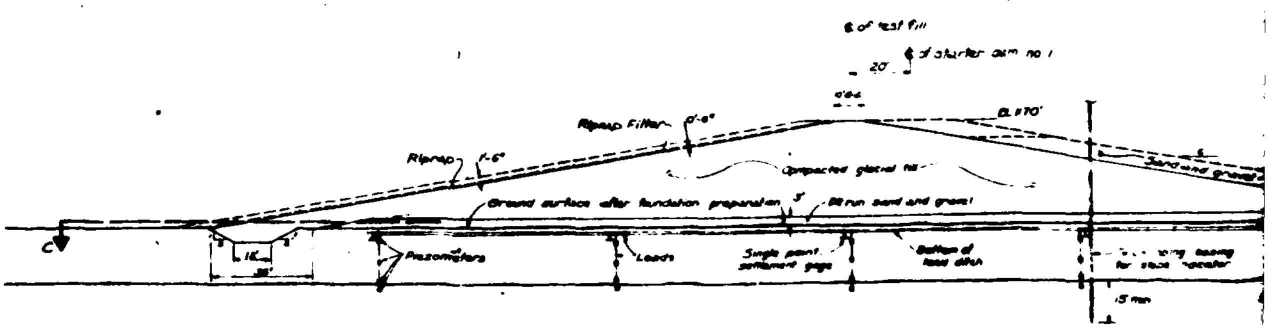
292-0202



LOCATION PLAN
Scale A

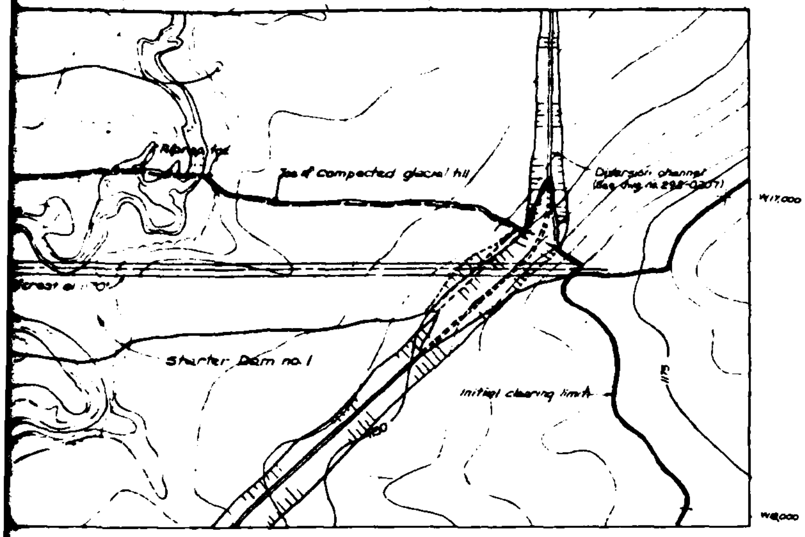


SECTION A-A
STARTER DAM TYPICAL SECTION
Scale B

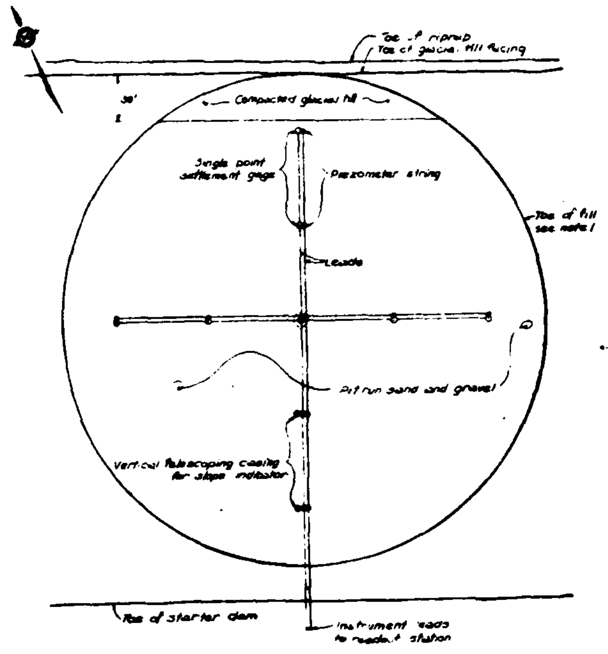


SECTION B-B
TEST FILL INSTRUMENT SECTION
Scale B

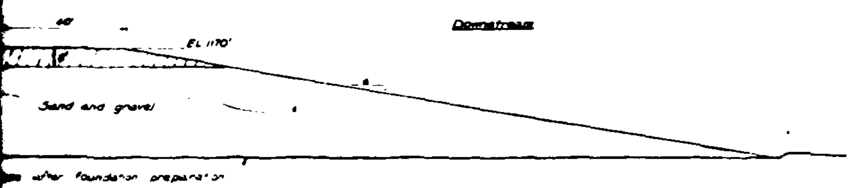
–		Preliminary - Issued to Reserve Mining Company	
1		Section C-C line altered, piezometer symbol altered,	
		one piezometer added at section B-B.	
		Riprap detail revised.	



PLAN



SECTION C-C
Scale C



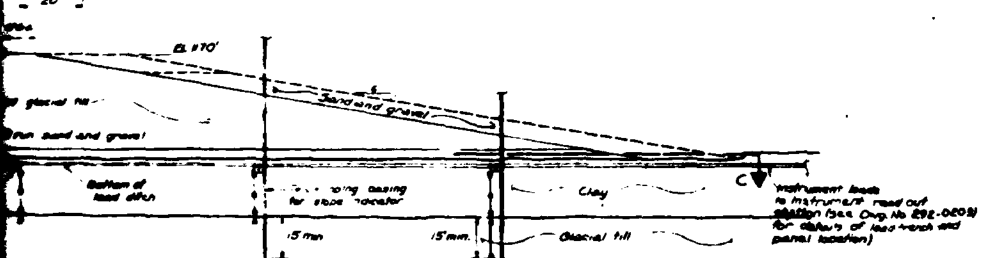
SECTION A-A
STARTER DAM TYPICAL SECTION
Scale B

NOTES

1. Toe of conical test fill shown is schematic only.
2. Cut-off trench to be excavated into low permeability clay or glacial till. Minimum depth of trench 2 ft below clay surface or 4 ft below glacial till surface. Backfill to be compacted glacial till.
3. Locations of instruments are schematic only. Instruments to be installed in locations and to depths as directed by the Engineer.

REFERENCE DRAWINGS:

292-0200 Damsite No 1 - General Arrangement
292-0203 Damsite No 1 - Instrumentation



SECTION B-B
TEST FILL INSTRUMENT SECTION
Scale B

Scale C
Scale B
Scale A

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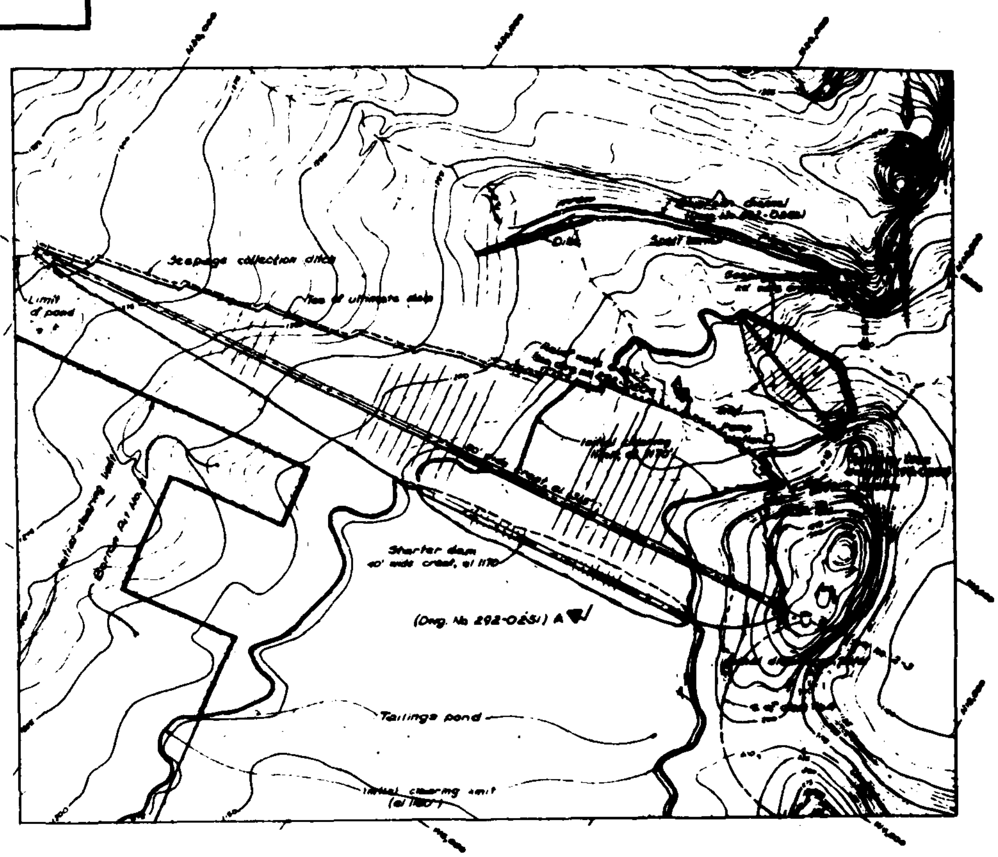
SILVER BAY, MINNESOTA
RESERVE MINING COMPANY
DAM SITES
A-8
MILE POST NO 7 SITE
TAILING DISPOSAL AREA
DAMSITE NO 1 —
STARTER DAM AND TEST FILL
Exhibit 8
REVISION 1
As shown

292-0250



LOCATION PLAN
Scale A

—	[illegible]	Preliminary - Issued to Reserve Mining Company
1	[illegible]	Diversion channel relocated, riprap revised

BILL OF MATERIAL

NOTES

1. Pump station and reclaim pipeline locations are schematic only.
2. Detailed alignment of diversion channel around seepage recovery dam 2-3 to be determined after survey profile and cross sections completed.
3. Initial clearing limits shown provide sufficient area for construction to month 36.
4. Surface and pressure grouting of rock is required along upstream toe of tailings dam east abutment.
5. Clearing for stream diversion to be included in initial clearing. For clearing limits see drawing No. 292-0256.

REFERENCE DRAWINGS:

292-0120	General Layout and Location Plan
292-0251	Damsite No 2-3 - Sections and Details
292-0252	Damsite No 2-3 - Starter Dam
292-0253	Damsite No 2-3 - Instrumentation
292-0254	Damsite No 2-3 - Grouting
292-0255	Damsite No 2-3 - Seepage Recovery Dam 2-3
292-0256	Damsite No.2-3 - Diversion at Seepage Recovery Dam

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SILVER BAY, MINNESOTA

RESERVE MINING COMPANY

DAM SITES

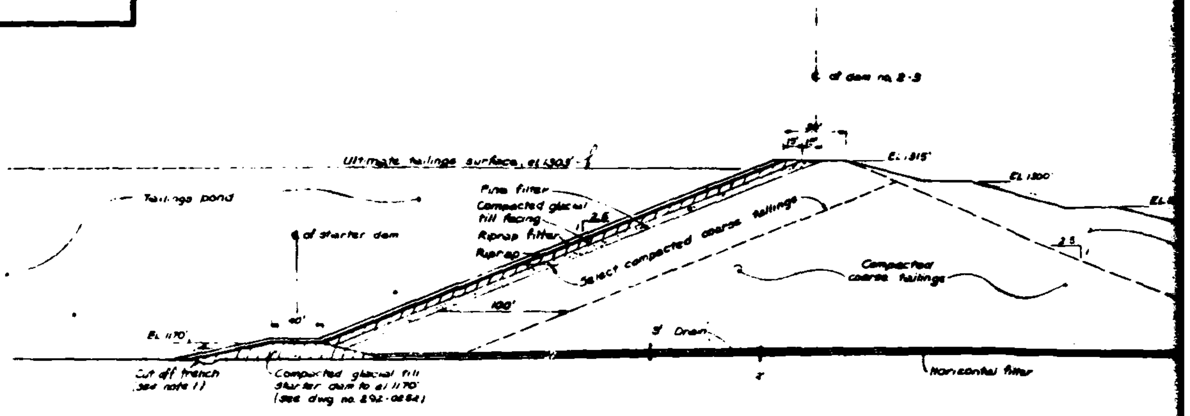
A-9

MILE POST No 7 SITE
TAILING DISPOSAL AREA
DAMSITE No 2-3

Exhibit 9

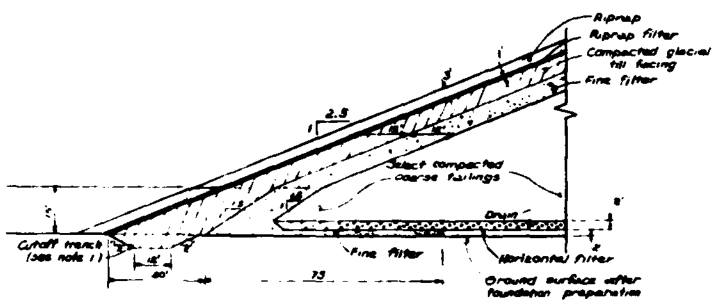
23

292-0251



SECTION A-A (Dwg No 292-0250)

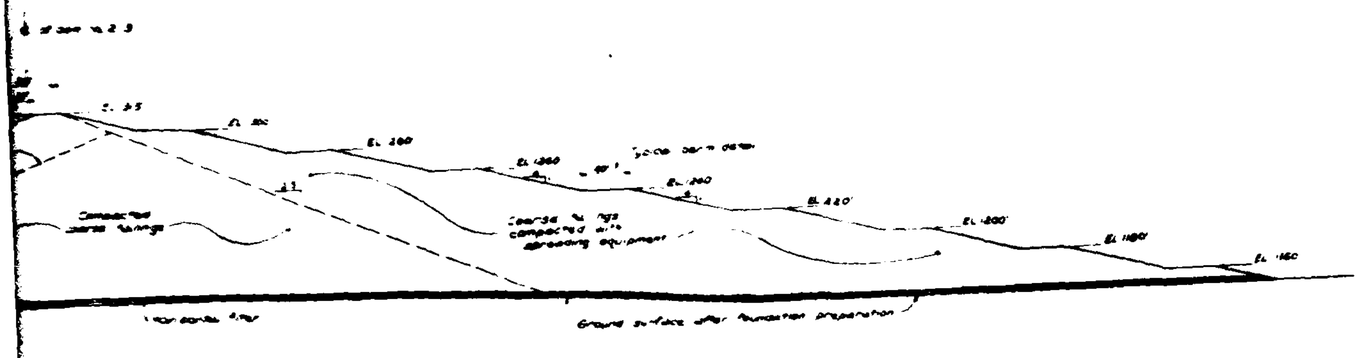
Scale A



UPSTREAM TOE DETAIL - ABOVE EL 1170

Scale B

No.	Date	Revision
–	[illegible]	Preliminary – Issued to Reserve Mining Company
1	[illegible]	Riprap detail revised.
		Select compacted coarse tailings zone added



SECTION A-A (Dwg No 292-0250)

Scale A

NOTES

1. Cutoff trench to be excavated into low permeability clay or glacial till. Minimum depth 2 ft below clay surface or 4 ft below glacial till surface. Backfill to be compacted glacial till.

REFERENCE DRAWINGS

292-0100	Tailings Storage Dam - Construction Staging
292-0250	Details No 2-3 - General Arrangement
292-0252	Details No 2-3 - Starter Dam

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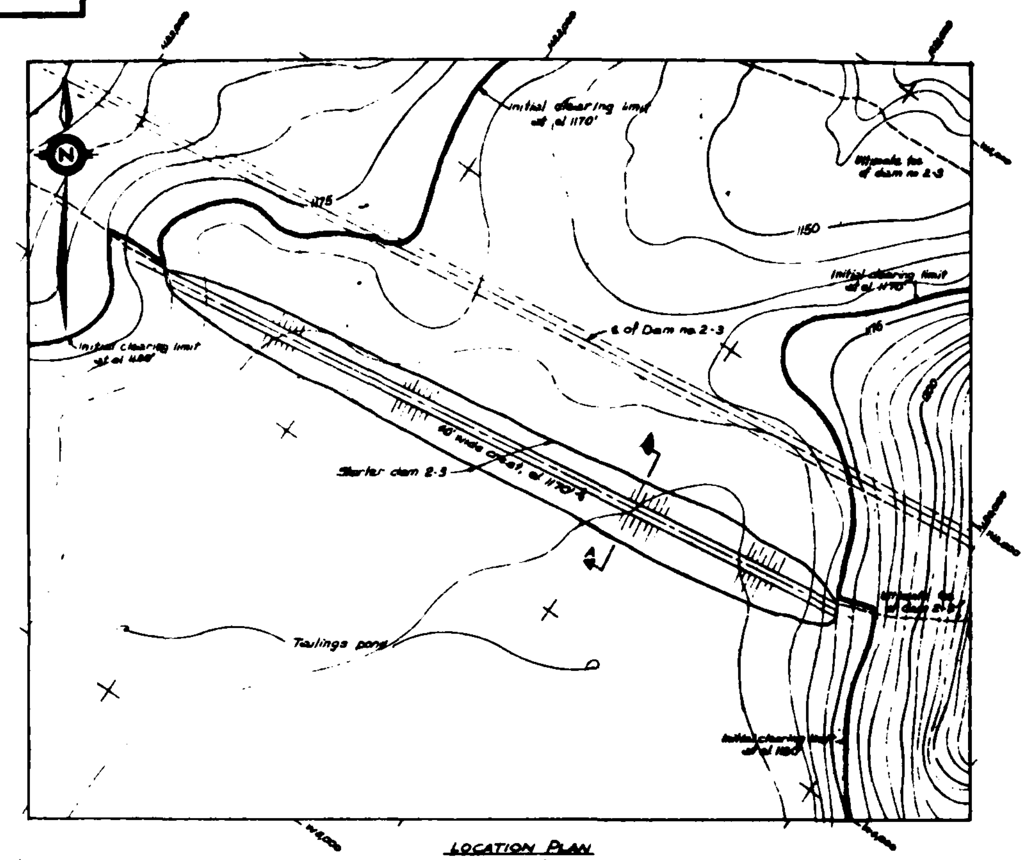
Silver Bay, Minnesota RESERVE MINING COMPANY

A-10

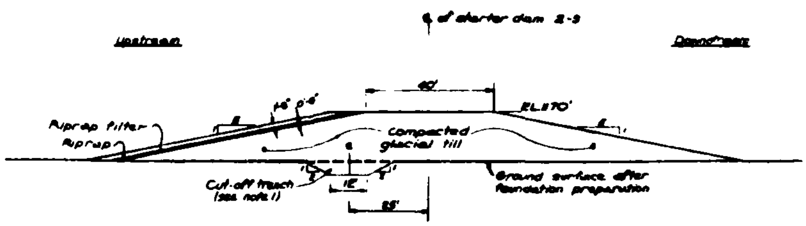
Mile Post No 7 Site
Tailing Disposal Area
Damsite No 2-3
Sections and Details

Exhibit 10

292-0252



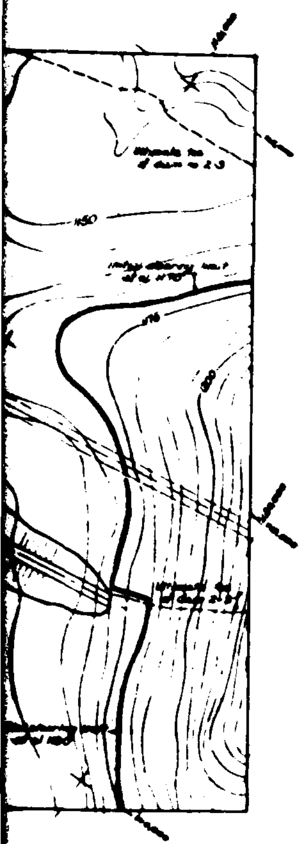
LOCATION PLAN
Scale A



SECTION A-A
Scale B

—	[illegible]	Preliminary - Issued to [illegible] Mining Company	
1	[illegible]	[illegible] Note 1 [illegible] Cut-off [illegible]	

23



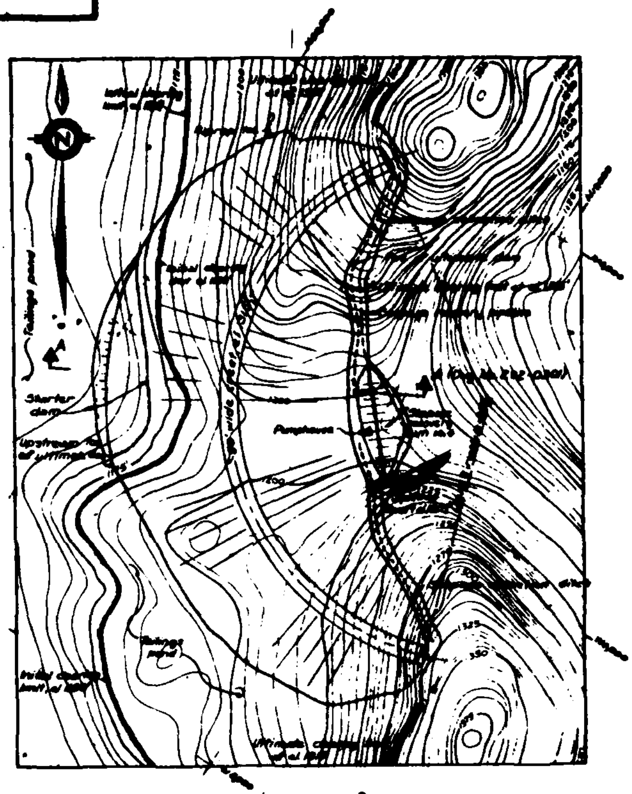
RESERVE MINING COMPANY

A-11

Mile Post No 7 Site

Exhibit 11

2 3



LOCATION PLAN

Scale A

No.	Date	Description
–	[illegible]	Preliminary - issued to Reserve Mining Company
1	[illegible]	Berms altered, starter dam altered, clearing limit altered. Seepage recovery dam added

23

NOTES:

1. Initial clearing limits shown provide sufficient area for construction to month 36.
2. The design is tentative; foundation investigation and detailed design yet to be done. Seepage recovery dam design is schematic only.

REFERENCE DRAWINGS:

292-0120	General layout and Location Plan
292-0129	Construction Railway - General Arrangement
292-0160	Tailings Storage Dams - Construction Staging
292-0182	Seepage Recovery Dams - Reservoir Volume curves and mass curves
292-0301	Damsite No.4 - Sections and Details
292-0302	Damsite No.4 - Starter Dam

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RESERVE MINING COMPANY

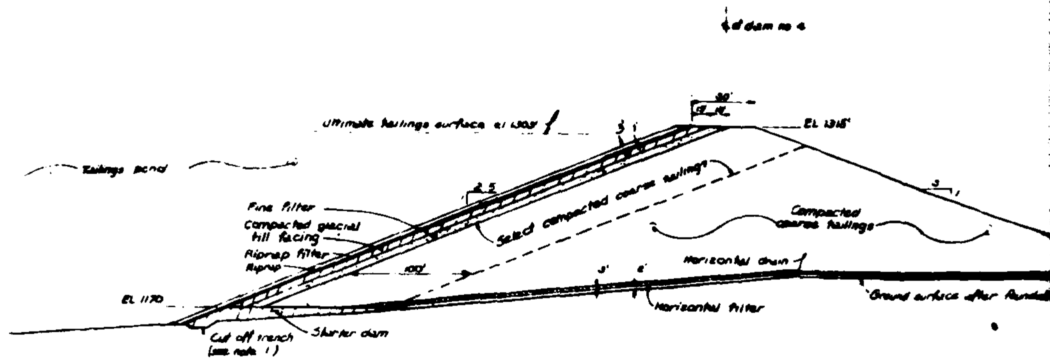
A-12

MILE POST No. 7 SITE
TAILING DISPOSAL AREA
DAMSITE No. 4
GENERAL ARRANGEMENT

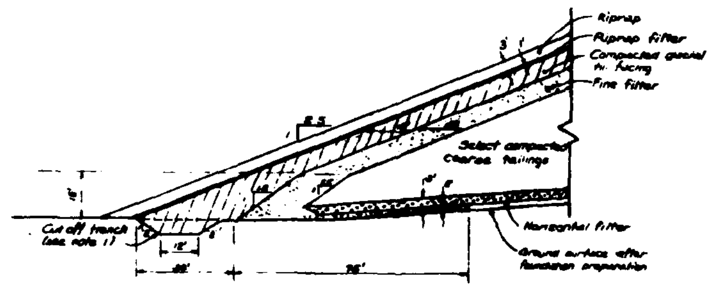
Exhibit 12

2

292-0301

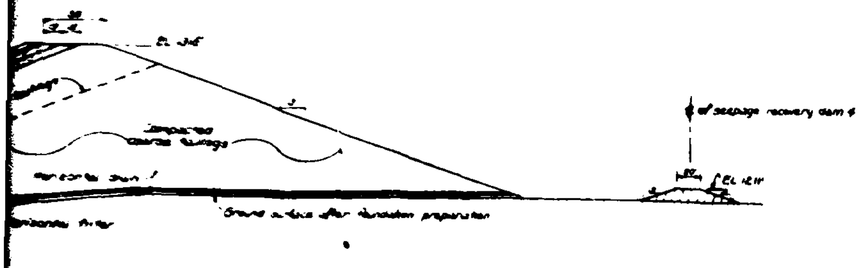


SECTION A-A (Dwg. No. 292 0300)
Scale A

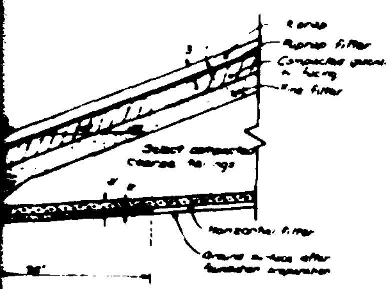


UPSTREAM TOE DETAIL - ABOVE EL 1170
Scale B

No.	Date	Description
0	[illegible]	Preliminary - issued to Reserve Mining Company
1	[illegible]	Riprap detail added, starter [illegible] section altered select coarse tailings zone added, [illegible]



SECTION A-A (Dwg No 292 0300)
Scale A



DAM TOE DETAIL - ABOVE EL 1170
Scale B

NOTES

1. Cut-off trench to be excavated into low permeability clay or glacial till. Minimum depth of trench 2 ft. below clay surface or 4 ft. below glacial till surface. Backfill to be compacted glacial till.
2. Design is tentative, foundation investigation and detailed design yet to be done.

REFERENCE DRAWINGS

292-0102	Seepage recovery dams - Reservoir volume curves and mass curves
292-0300	Damsite No. 4 - General Arrangement
292-0302	Damsite No 4 - Starter Dam

Scale B
Scale A

Klohn Leonoff Consultants Ltd.

SILVER BAY, MINNESOTA

RESERVE MINING COMPANY

A-13

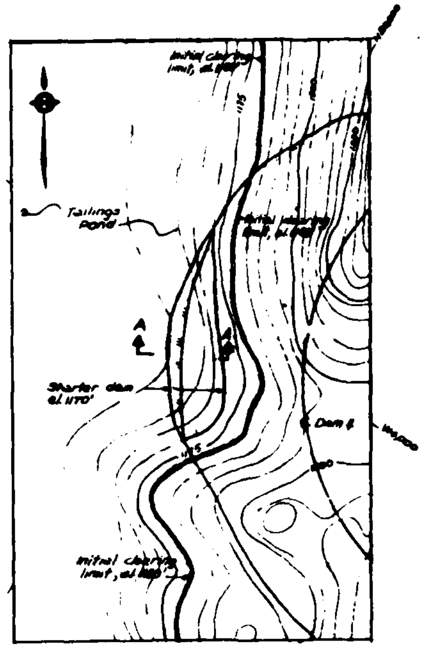
MILE POST No 7 SITE
TAILING DISPOSAL AREA
DAMSITE No 4
SECTIONS AND DETAILS

Exhibit

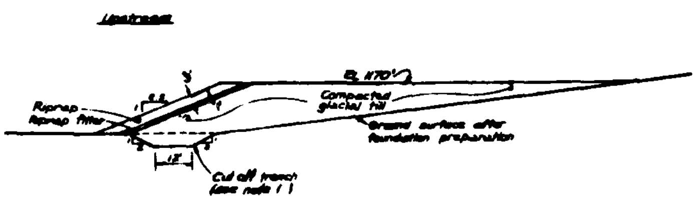
Scale As Shown

Revision 1

292-0302



LOCATION PLAN
Scale: A



SECTION A-A
Scale: B

–	[illegible]	Preliminary - Issued to [illegible] Mining Company
1	[illegible]	Riprap added, revised Clearing limit altered.
		Starter dam altered.

NOTES:

1. Cut-off trench to be excavated into low permeability clay or glacial soil. Minimum depth of trench 2 ft below clay surface or 4 ft below glacial till surface. Backfill to be compacted glacial till.

REFERENCE DRAWINGS

[illegible] Damsite No. 4 - General arrangement

[illegible] Damsite No. 4 - Sections and Details

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CIVIL & GEOTECHNICAL ENGINEERS

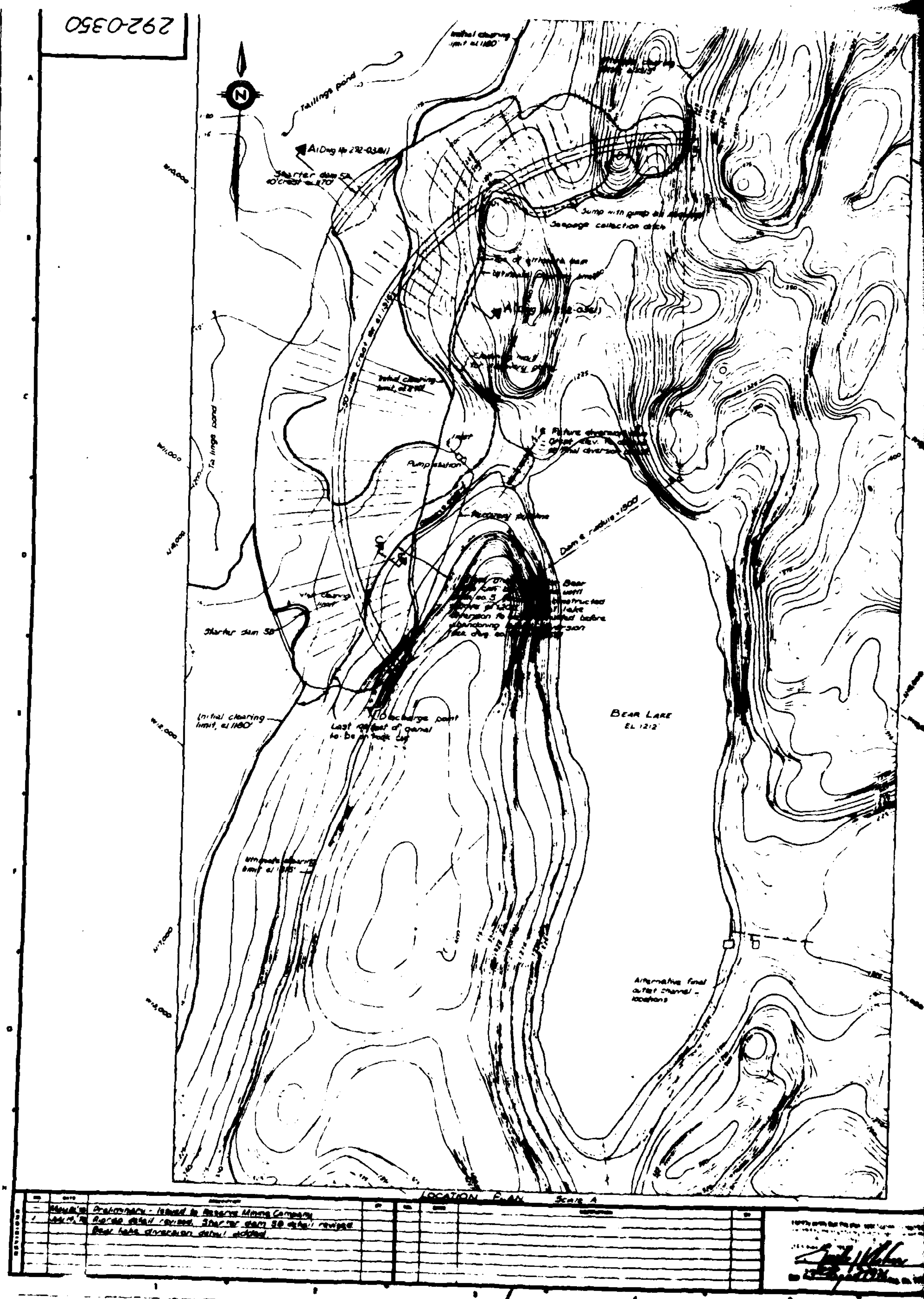
Silver Bay, Minnesota RESERVE MINING COMPANY

A-14

Mile Post No 7 Site
Tailing Disposal Area
Damsite No 4
Starter Dam

Exhibit 14

1 2


292-0350
N
Tailings pond
Starter dam 5A
Sump with pump
Seepage collection ditch
Initial clearing limit, el 1180'
Tailings pond
Pumpstation
Future diversion
Reclaim pipeline
Dam radius 1800
Starter dam 5B
Discharge point
Ultimate clearing limit
Bear Lake
EL 1212'
Alternative final outlet channel locations
LOCATION PLAN Scale A
Preliminary - Issued to Reserve Mining Company
Riprap detail revised. Starter dam 5B detail revised
Bear Lake diversion detail added.

NOTES:

1. The initial clearing limits shown provide sufficient area for construction to month 30.
2. The design is tentative; foundation investigation and detailed design yet to be done
3. The alignment of the initial diversion for Bear Lake is tentative. Design to be finalized after survey profile and cross sections done.
4. Pump station and reclaim pipeline locations are schematic only. Detailed design to be done by others

REFERENCE DRAWINGS:

292-0120	General Layout and Location Plan
292-0120	Construction Railway - General Arrangement
292-C100	Tailings Storage Dams - Construction Staging
292-0182	Seepage Recovery Dams - Reservoir Volume Curves and Area Curves
292-0351	Damsite No. 5 - Sections and Details
292-0352	Damsite No. 5 - Starter Dams
292-0355	Damsite No. 5 - Bear Lake Diversion Details

Scale A

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SILVER BAY, MINNESOTA — RESERVE MINING COMPANY

A-15

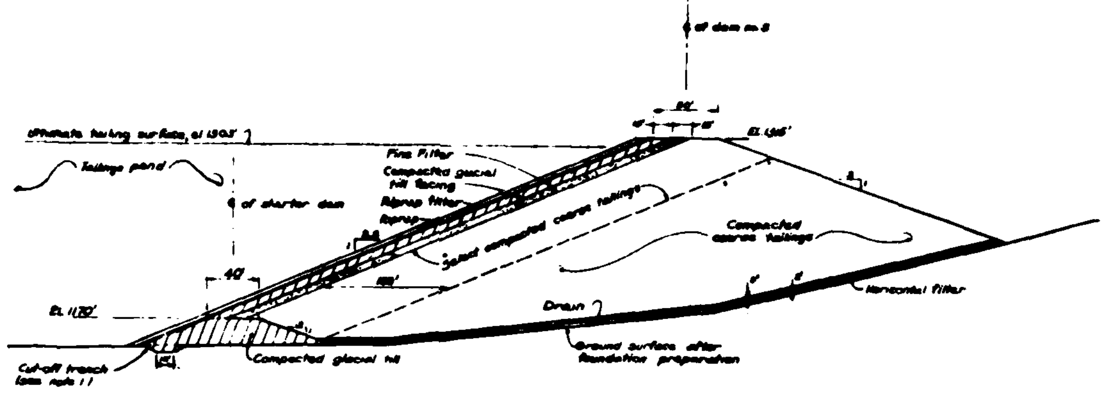
MILE POST NO. 7 SITE
TAILINGS DISPOSAL AREA
DAMSITE NO. 5
GENERAL ARRANGEMENT

Exhibit

REVISION 1

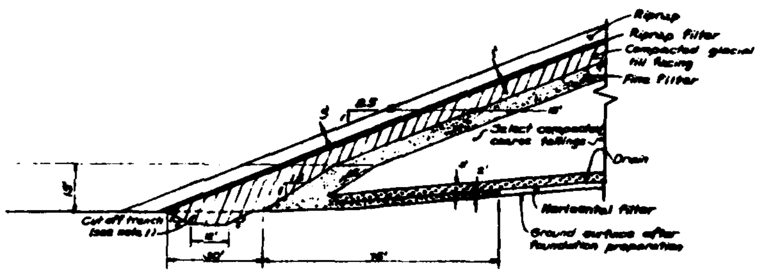
2?

292-0351



SECTION A-A (Dwg No. 292-0350)

Scale A



UPSTREAM TOE DETAIL - ABOVE EL 1170

Scale B

–	[illegible]	Preliminary - Issued to Reserve Mining Company
1	[illegible]	Riprap detail revised
		Select compacted coarse tailing area added

[illegible]

1. [illegible]
2. [illegible]

[illegible]

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

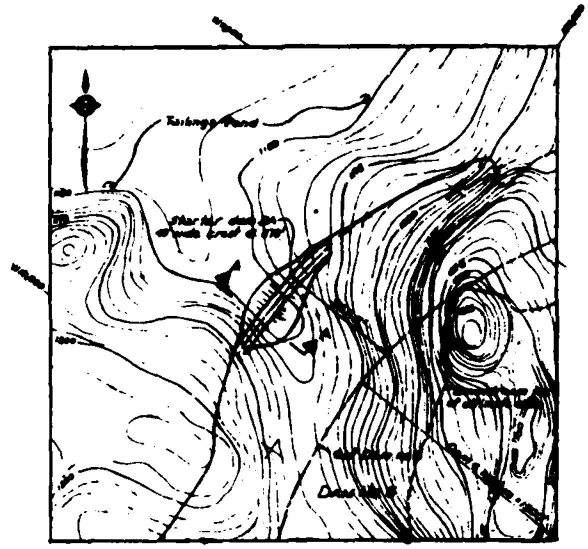
RESERVE MINING COMPANY

A-16

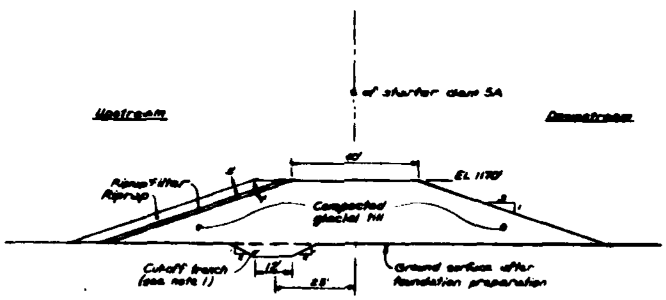
Mile Post No. 7 Site
Tailings Disposal Area
Dumpsite No. 5
Sections and Details

Exhibit 16

292-0352

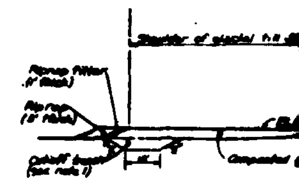


LOCATION PLAN
Scale: A



SECTION A-A
Scale: B

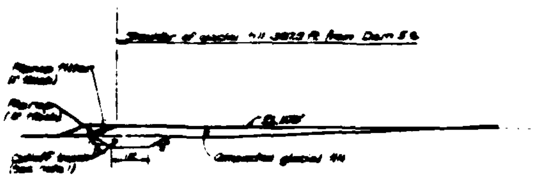
LOCATION PLAN
Scale: A



SECTION B-B
STARTER DAM 5B SECTION
Scale: B

—	Preliminary - Issued to Resource Mining Company
1	Ponds slightly revised
	Starter dam 5B revised

LOCATION PLAN



SECTION B-B
STARTER DAM 5B SECTION

NOTE

1. Cut-off trench to be excavated into low permeability clay or glacial till. Minimum depth of trench 2 ft. below clay surface or 4 ft. below glacial till surface. Backfill to be compacted glacial till.

Damsite No. 5 - General Arrangement
Damsite No. 5 - Sections and details

Klohn Leonoff Consultants Ltd.

RESERVE MINING COMPANY

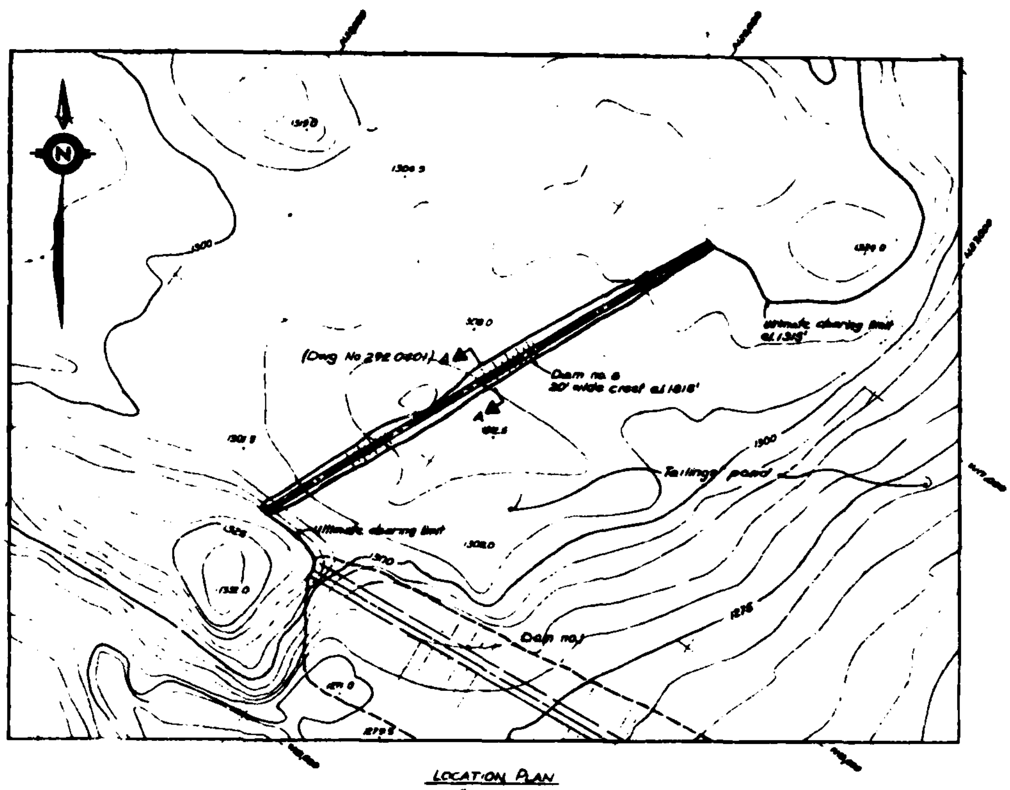
A-17

MILE POST No 7 SITE
TAILINGS DISPOSAL AREA

DAMSITE No 5
STARTER DAMS

Exhibit

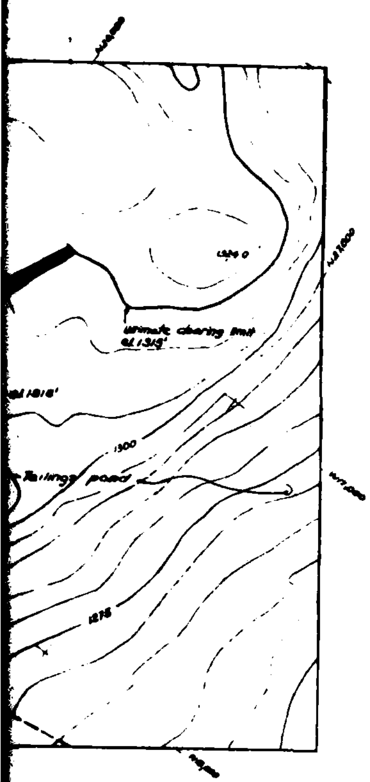
292-0400



LOCATION PLAN
Scale A

–		Preliminary - Issued to [illegible] Mining Company
1		Berms added on Dam no1 [illegible]

2-3



NOTES.

1. The design is tentative; foundation investigation and detailed design yet to be done.

REFERENCE DRAWINGS

292-0120	General Layout and Location Plan
292-0160	Tailing Storage Dams - Construction Staging
292-0200	Damsite No 1 - General Arrangement
292-0401	Damsite No 6 - Sections and Details

Klohn Leonoff Consultants Ltd.
CIVIL & GEOTECHNICAL ENGINEERS

SILVER BAY MINNESOTA RESERVE MINING COMPANY DAM SITES

LCB

A-18

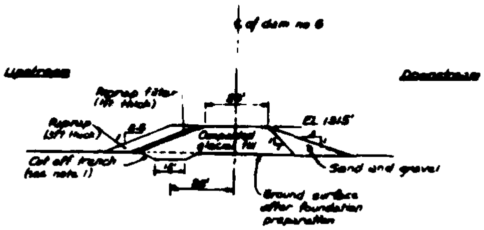
MILE POST No. 7 SITE
TAILING DISPOSAL AREA

DAMSITE No 6
GENERAL ARRANGEMENT

Exhibit 1

2

292-0401



SECTION AA (Dwg no 292-0400)
Scale A

—	[illegible]	Preliminary - issued to Reserve Mining Company	
1	[illegible]	Dimensions were altered	

1 2 3 4 5

23

RESERVE MINING COMPANY

MILE POST No. 7 SITE
TAILING DISPOSAL AREA

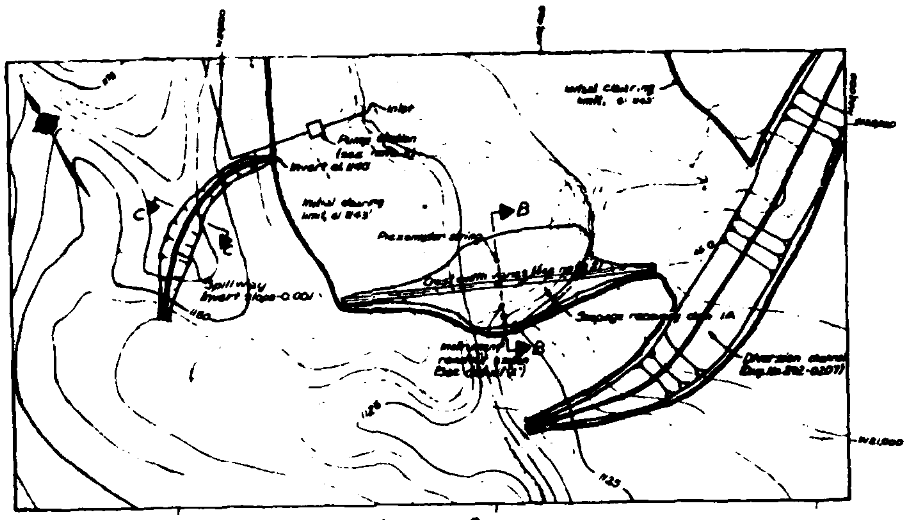
DAMSITE No. 6
SECTIONS AND DETAILS

A-19

Exhibit 19

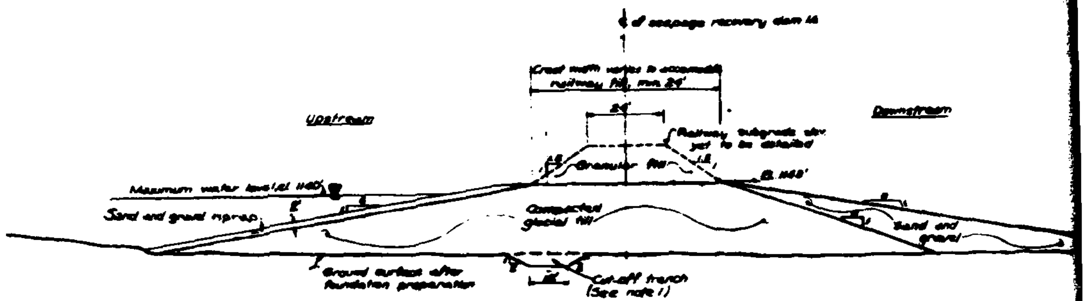
23

292-0205



LOCATION PLAN

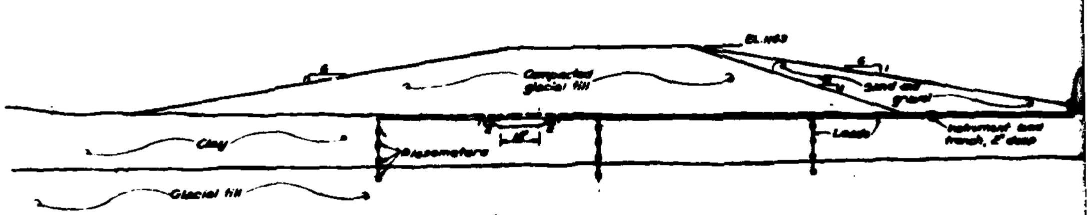
Scale: A



SECTION B-B

SEEPAGE RECOVERY DAM 1A

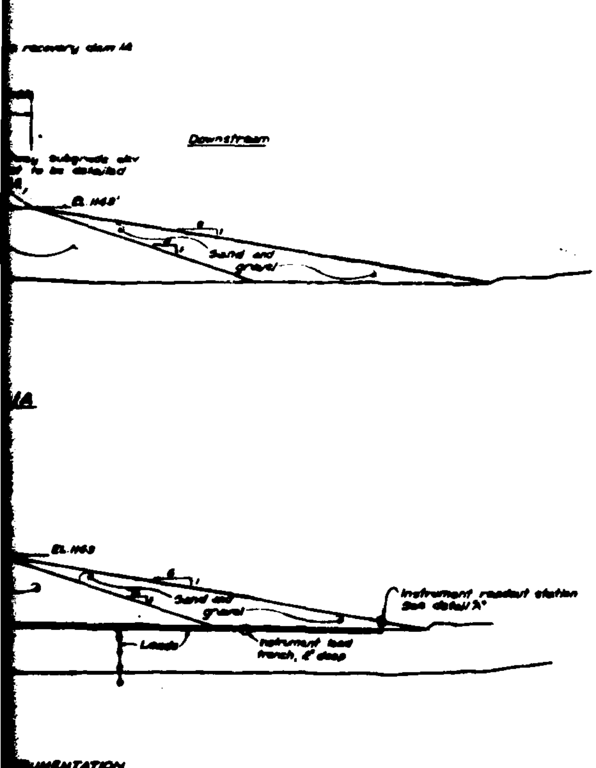
Scale B

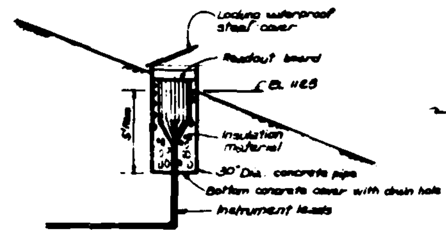


SECTION B-B

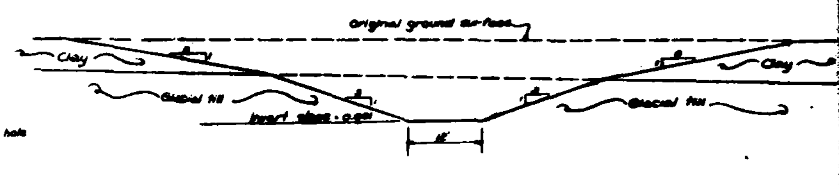
SEEPAGE RECOVERY DAM 1A INSTRUMENTATION

Scale B





DETAIL 'A'
INSTRUMENT READOUT STATION
Scale D



SECTION C-C
SPILLWAY CHANNEL
Scale: C

NOTES:

1. Cut-off trench to be excavated into low permeability clay or glacial till. Minimum depth of trench 2 ft below clay surface or 4 ft below glacial till surface. Backfill to be compacted glacial till.
2. Locations of instruments are schematic only. Instruments to be installed at locations and to depths as directed by the Engineer.
3. Pump station and recycle pipeline locations are schematic only. Detailed design to be done by others.
4. Spillway shown is schematic only. Design to be finalized after topographical survey and further subsurface investigation.
5. The crest width of the dam varies and is dependent on the railway grade to be established by Reserve Mining Company.

REFERENCE DRAWINGS:

Scale: D
Scale: C
Scale: B
Scale: A

Klohn Leonoff Consultants Ltd.

RESERVE MINING COMPANY

A-20

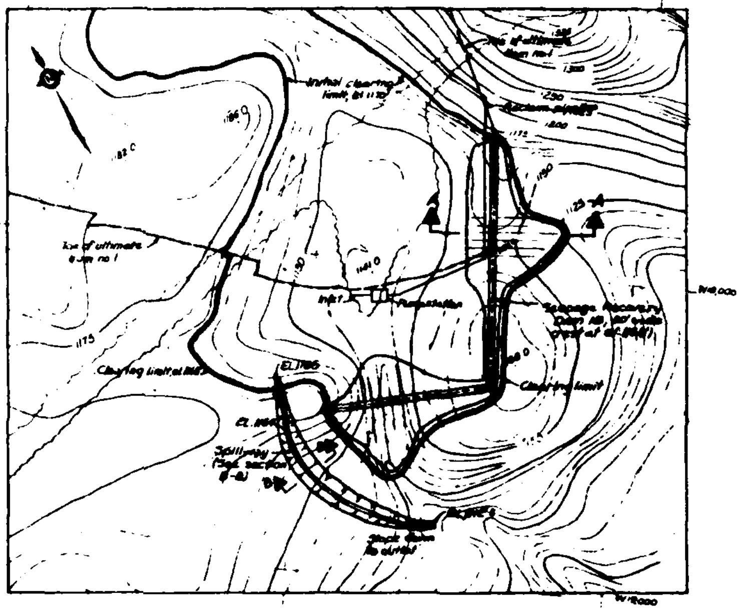
MILE POST No. 7 SITE
TAILING DISPOSAL AREA
DAMSITE No. 1 -
SEEPAGE RECOVERY DAM 1A

Exhibit

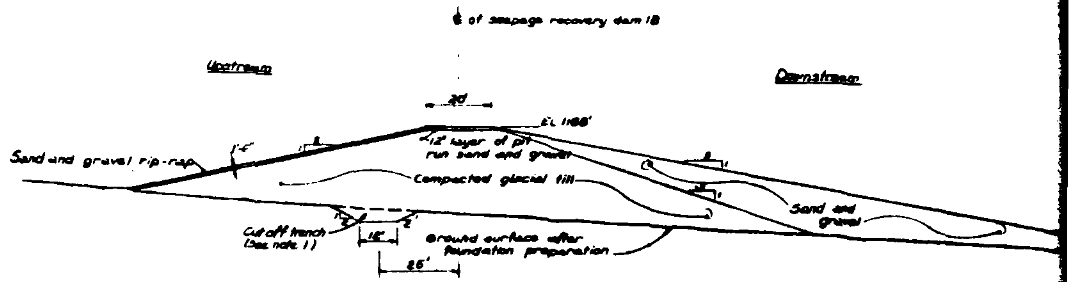
2

2[3]

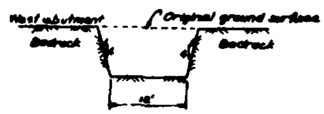
292-0206



LOCATION PLAN
Scale A

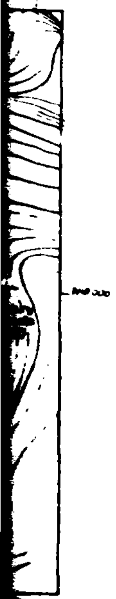


SECTION A-A
SEEPAGE RECOVERY DAM 1B
Scale: B



SECTION B-B
SPILLWAY AT SEEPAGE RECOVERY DAM 1B
Scale: C

No.	Date	Revision
–	[illegible]	Preliminary - Issued to Reserve Mining Company
1	[illegible]	Sand and gravel zone added, note 1 altered, cutoff trench revised.



NOTES:

1. Cut-off trench to be excavated into low permeability clay or glacial till. Minimum depth of trench 2 ft. below clay surface or 4 ft. below glacial till surface. Backfill to be compacted glacial till.
2. The design and alignment of the spillway and channel is schematic only and will be finalized after topographical survey and further subsurface investigation.
3. Pump station and reclaim pipeline locations are schematic only.

REFERENCE DRAWINGS

202-0120 General Layout and Location Plan
202-0182 Seepage Recovery Dams - Reservoir Volume Curves and Mass Curves
202-0200 Damsite No. 1 - General Arrangement

Scale: B
Scale: A

Klohn Leonoff Consultants Ltd.

Silver Bay, Minnesota RESERVE MINING COMPANY

A-21

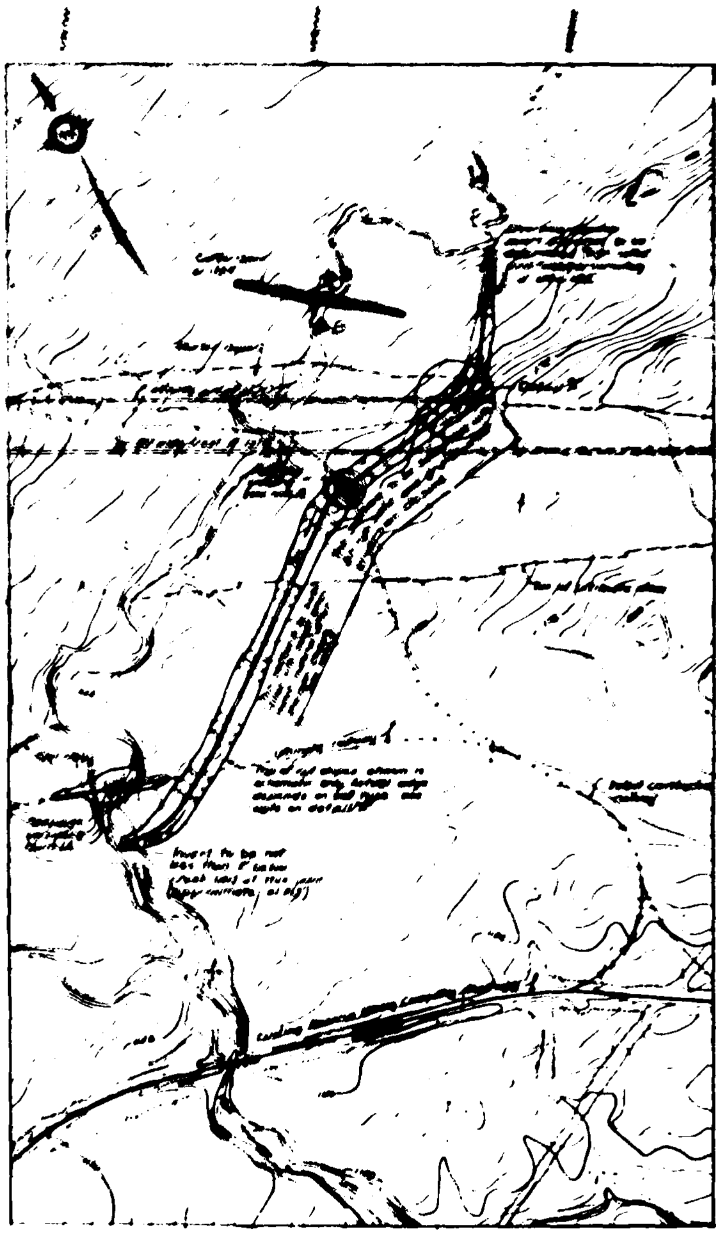
Mile Post No. 7 Site
Tailing Disposal Area
Damsite No. 1
Seepage Recovery Dam 1

Exhibit 2

1

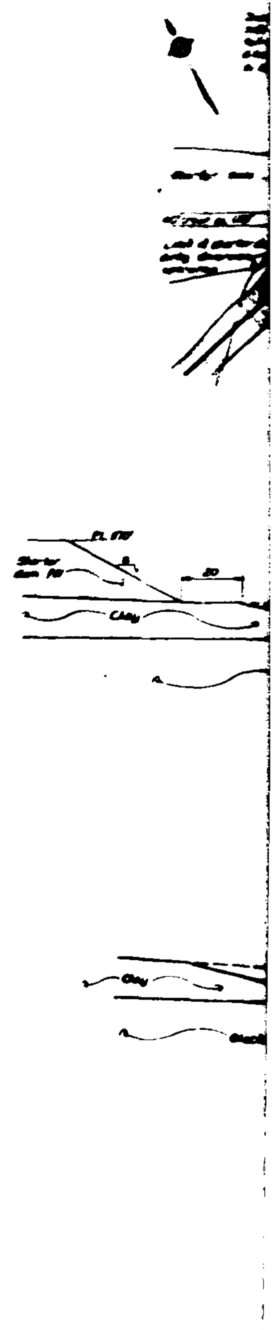
2

1025-222

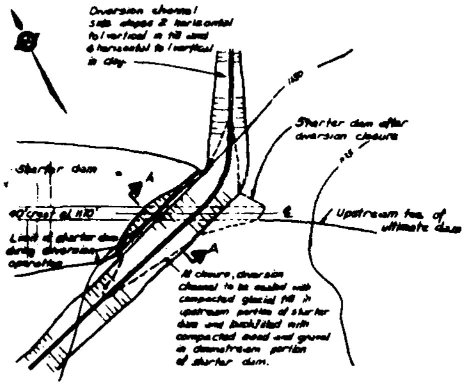


LOCATION PLAN

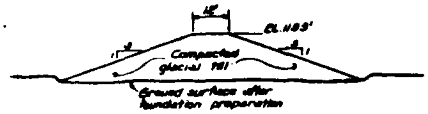
Scale A



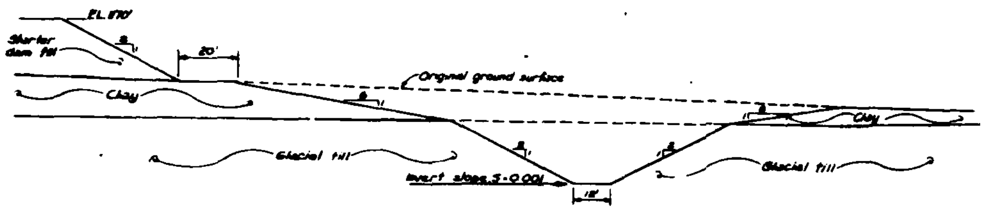
Rev.	Date	Description
-	[illegible]	Preliminary. Issued to [illegible] Mining Company
1	[illegible]	[illegible]



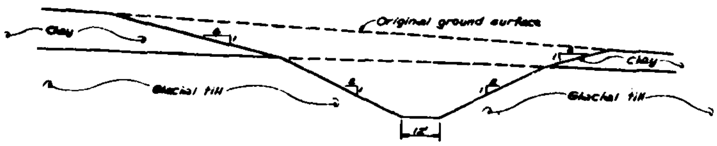
DETAIL 'A'
Scale B



SECTION B-B
COFFERDAM CROSS-SECTION
Scale C



SECTION A-A
Scale: C



DIVERSION CHANNEL
TYPICAL CROSS SECTION
Scale C

NOTES.

1. Detailed alignment of diversion channel to be determined after further surveys and subsurface investigations.
2. Glacial till fill for seepage recovery dam 1A may be obtained from the diversion cut.
3. Following closure of diversion, diversion channel to be backfilled to original ground level with select excavated material for 800 ft downstream of the downstream toe of the ultimate dam.
4. Tentative design for the railway crossing is a sand and gravel fill with 2-48" dia. CSP culverts. Final design to be completed after railway grades finalized.

REFERENCE DRAWINGS:

[illegible]	General layout and location plan
[illegible]	Construction railway - General Arrangement
[illegible]	Damsite No. 1 - General Arrangement
[illegible]	Damsite No. 1 - Seepage recovery dam 1A

Scale C
Scale B
Scale A

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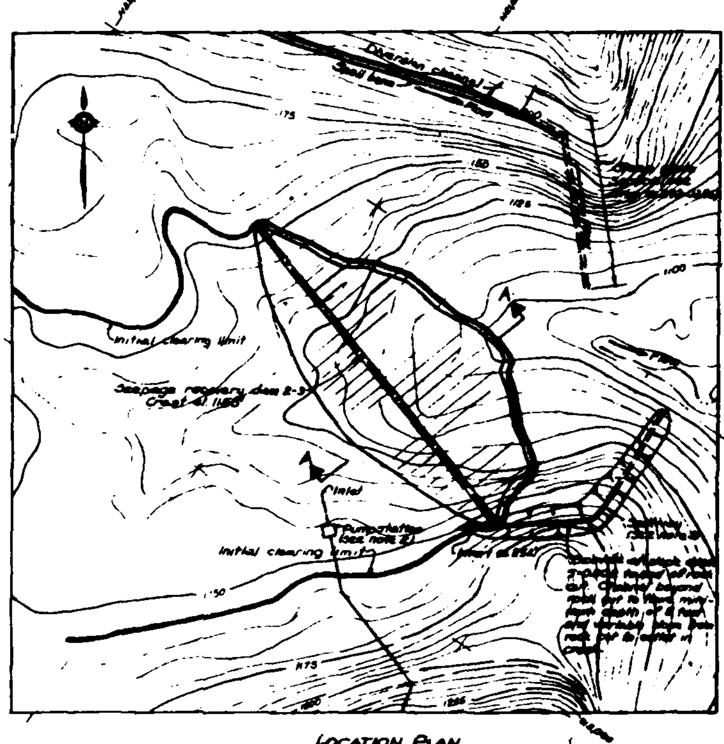
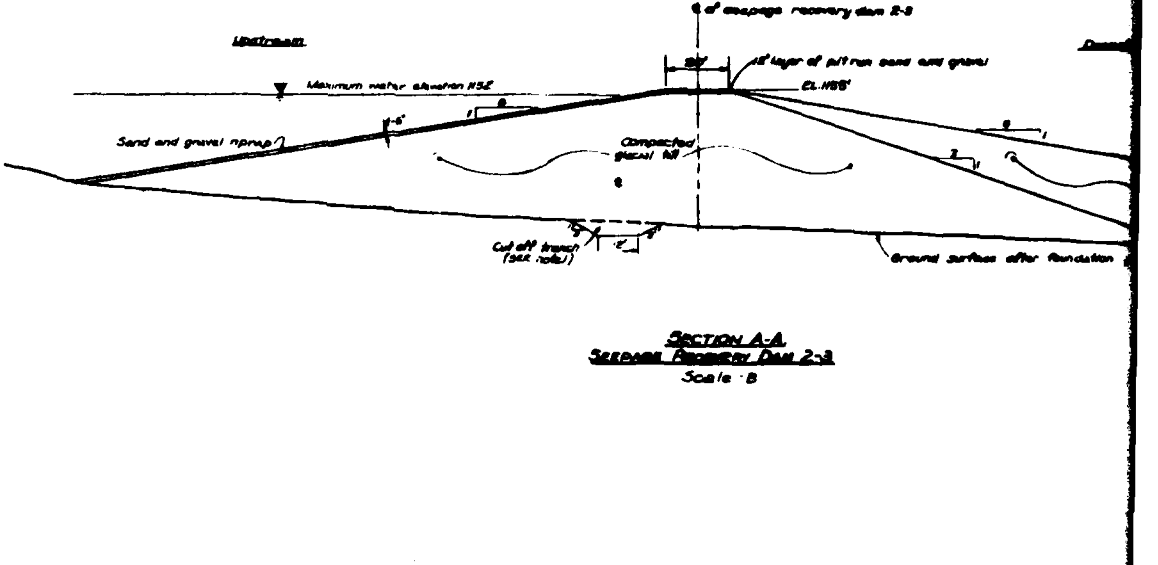
CIVIL & GEOTECHNICAL ENGINEERS

SILVER BAY, MINNESOTA
RESERVE MINING COMPANY
A-22
MILE POST No. 7 SITE
TAILING DISPOSAL AREA
DAMSITE No. 1
DIVERSION CHANNEL
Exhibit 22
REVISION 1

292-0255



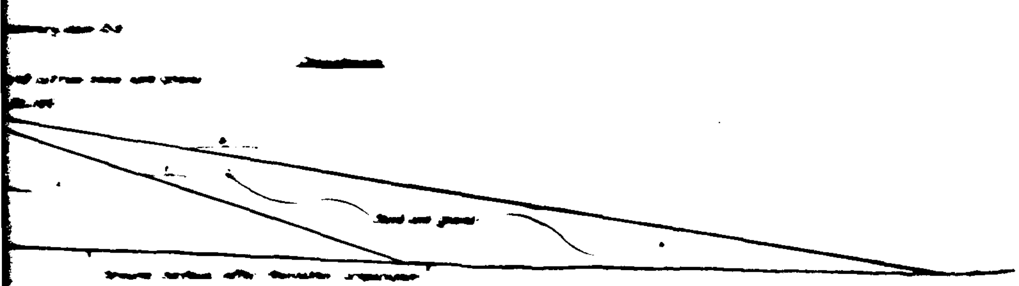
LOCATION PLAN
Scale A



SECTION A-A
SEEPAGE RECOVERY DAM 2-3
Scale B

—	[illegible]	Preliminary - issued to Reserve Mining Company
1	[illegible]	Diversion channel detail added, Spillway revised, sand and gravel zone added, cut off trench altered

23

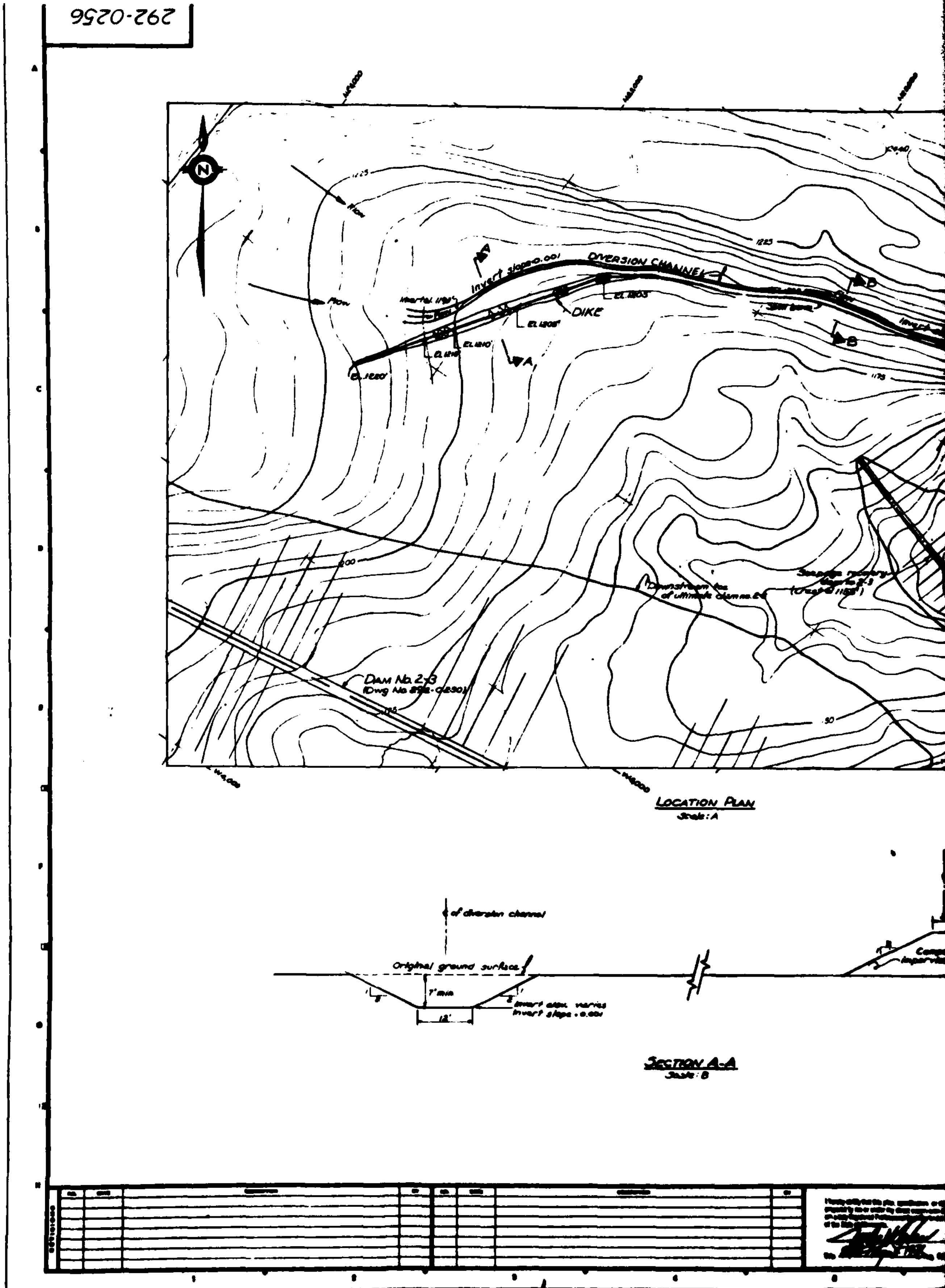


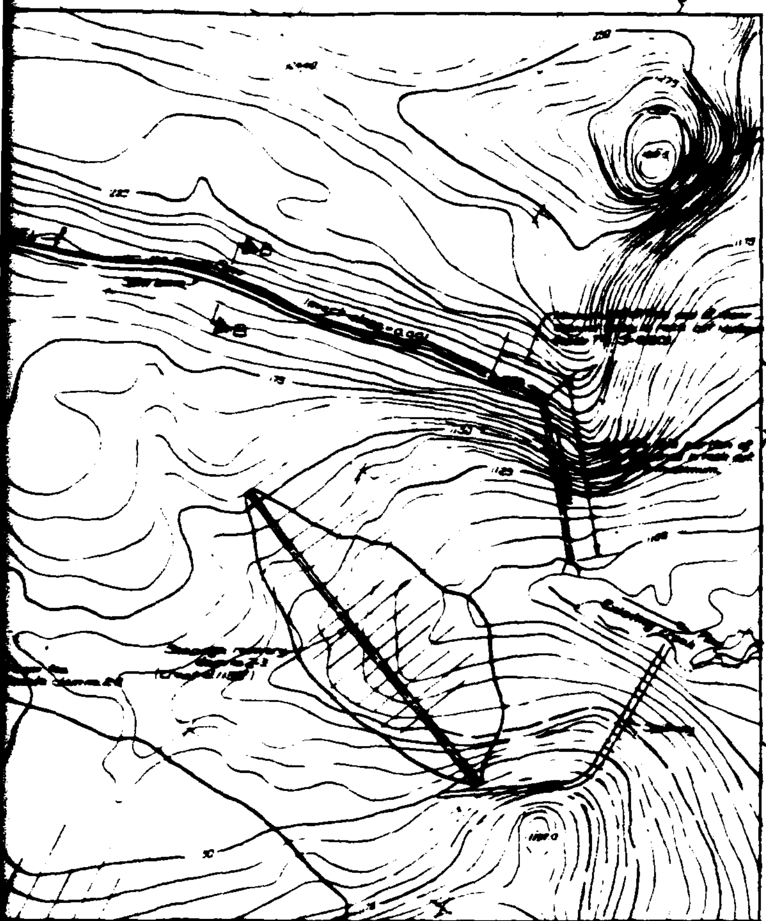
RESERVE MINING COMPANY

A-23

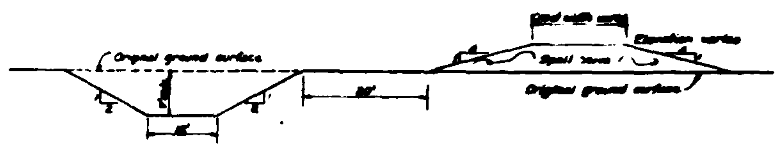
Mile Post No 7 Site
Tailing Disposal Area
Damsite No 2-3
Seepage Recovery Dam

Exhibit 2

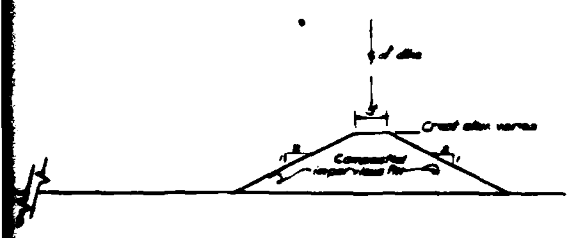

292-0256
Invert slope=0.001
DIVERSION CHANNEL
Flow
Flow
DIKE
EL. 1203
EL. 1208'
EL. 1210'
EL. 1220'
A
A
B
Dam No. 2-3
(Dwg No. 292-0230)
Downstream toe of ultimate dam no. 2-3
LOCATION PLAN
Scale: A
of diversion channel
Original ground surface
7' min
12'
Invert elev. varies
Invert slope = 0.001
SECTION A-A
Scale: B



...tion Plan
Scale: A



Section B-B
Scale B



...n A-A
...B

NOTES:
1. Diversion channel and spillway designs are tentative. Locations and designs to be finalized after topographic survey and subsurface exploration done.

REFERENCE DRAWINGS:
292-0250 Damsite No.2-3 - General Arrangement
292-0251 Damsite No.2-3 - Seepage Recovery Dam

Scale: B
Scale: A

RESERVE MINING COMPANY

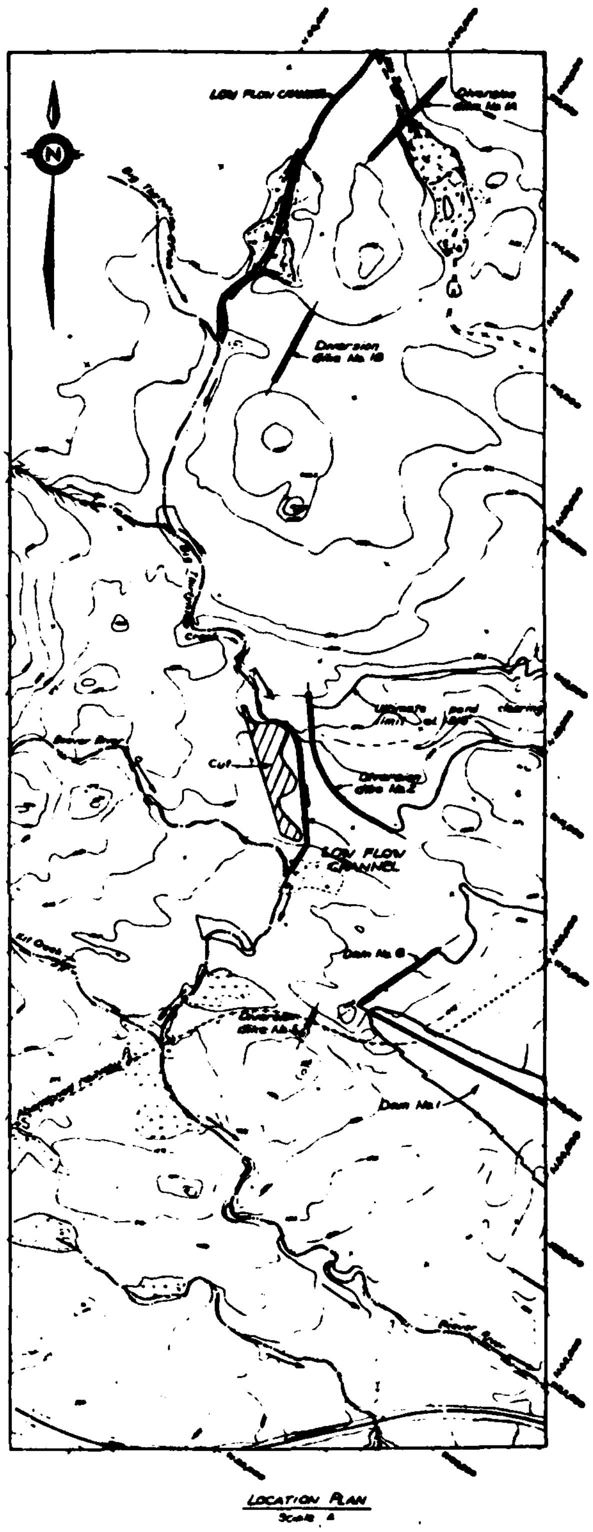
A-24

Mile Post No.7 Site
Tailing Disposal Area
Damsite No.2-3 - Diversion
At Seepage Recovery Dam

Exhibit 24

23

292-0410



LOCATION PLAN
Scale: A

—	[illegible]	Preliminary — Issued to Reserve Mining Company	
1	[illegible]	[illegible]	

23

NOTES:

1. Clearing for headwaters diversions to be included in the initial clearing. For details see dwgs. 292-0411 and 292-0413

REFERENCE DRAWINGS:

292-0[illegible]	General Layout and Location Plan
292-0411	Headwaters Diversion No. 1 - General Arrangement
292-0412	Headwaters Diversion No. 1 - Sections
292-0413	Headwaters Diversion No. 2 - General Arrangement
292-0414	Headwaters Diversion No. 2 - Sections

Klohn Leonoff Consultants Ltd.

SILVER BAY, MINNESOTA RESERVE MINING COMPANY

A-25

MILE POST NO 7 SITE
TAILING DISPOSAL AREA

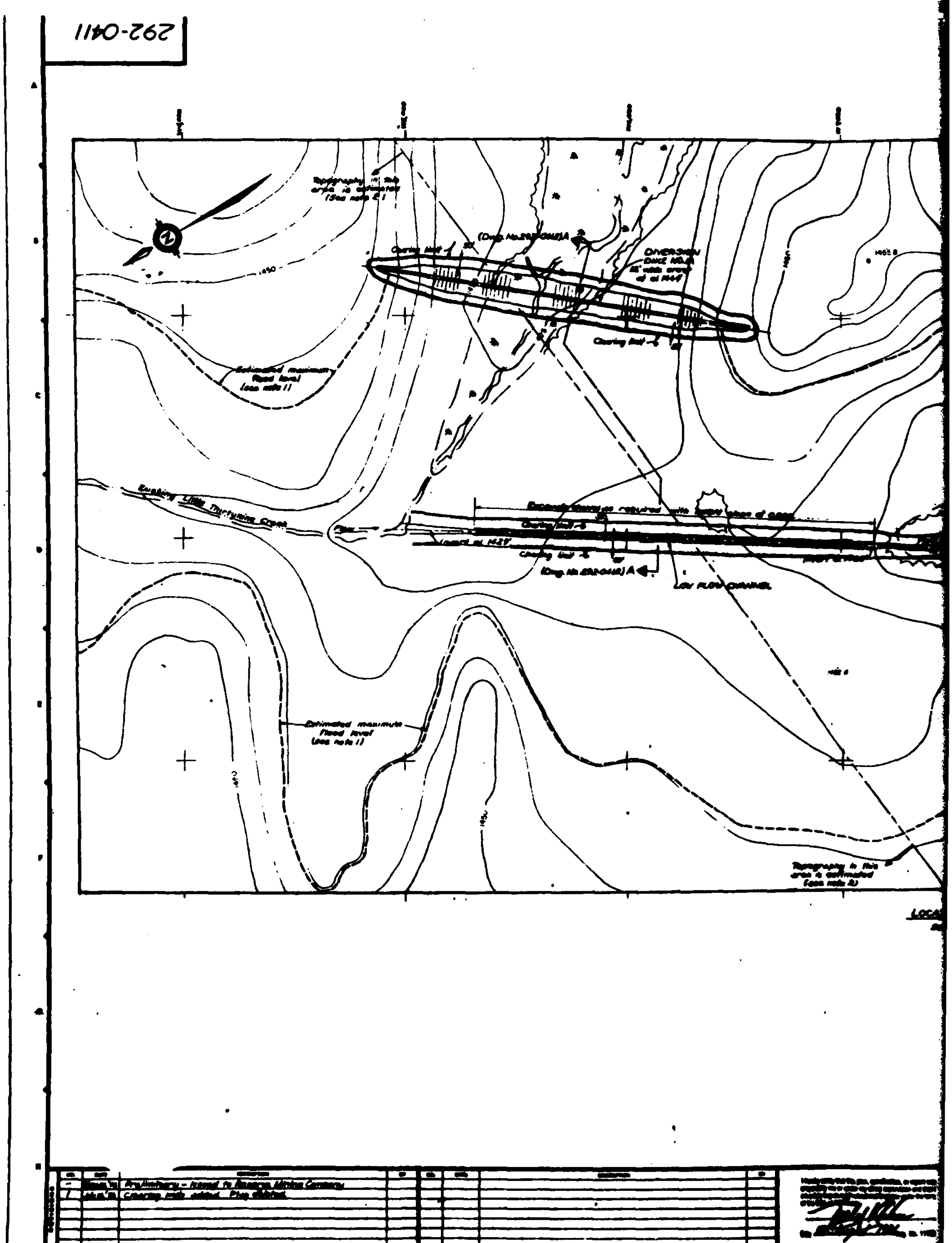
HEADWATERS DIVERSIONS
GENERAL ARRANGEMENT

Exhibit

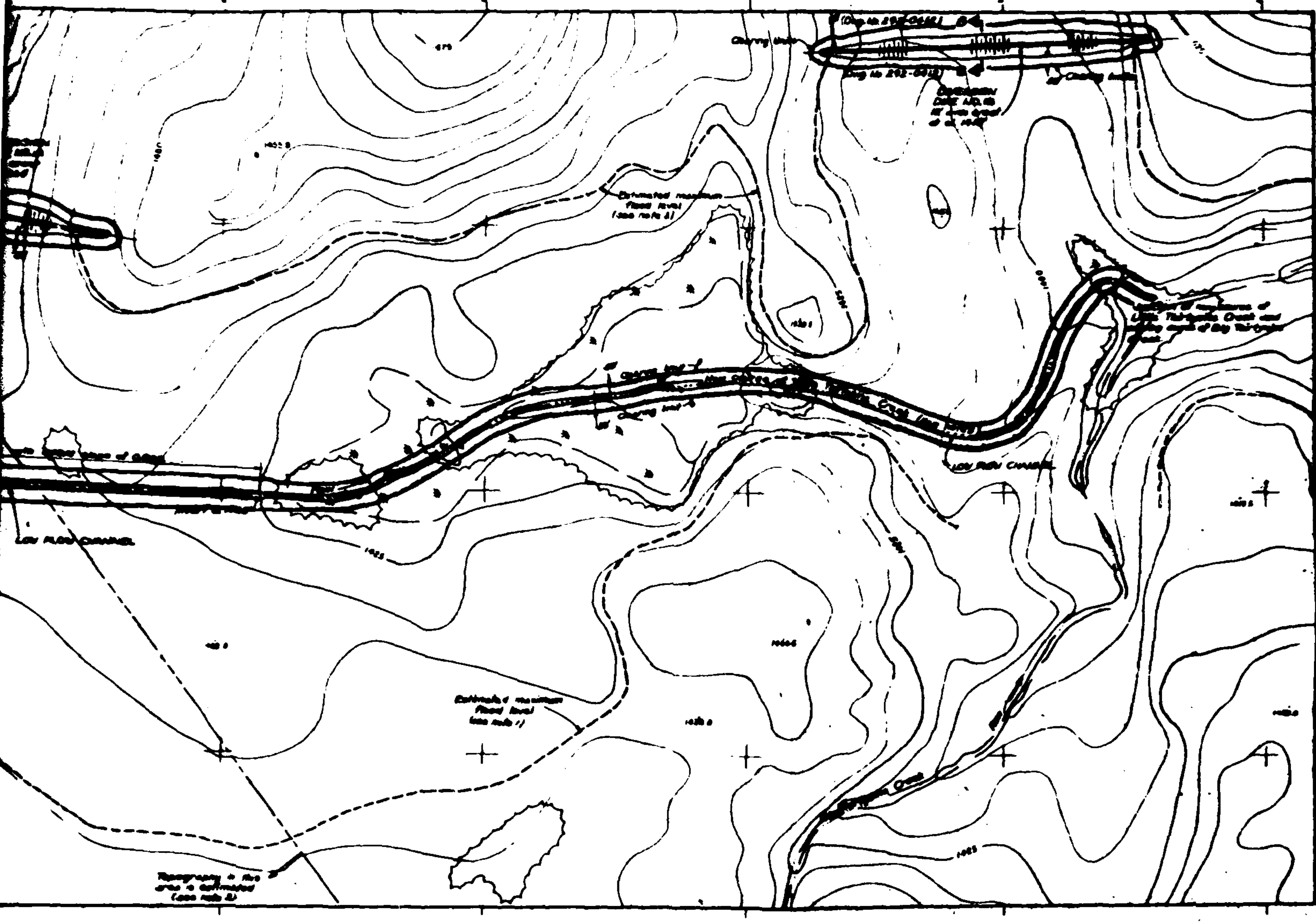
Scale: As shown

2

23



292-0411
DIVERSION
LOW FLOW CHANNEL
Estimated maximum flood level (see note 1)
Topography in this area is estimated
Preliminary - Issued to Reserve Mining Company



LOCATION PLAN
Scale A

NOTES:
1. The maximum flood level is based on a flow of 17,000 cfs in the Little Thirtynine creek.
2. The contours in the North-East corner of the plan as shown were interpolated from drawing No. [illegible] of scale 1 inch = [illegible] ft. Final design of dike No. [illegible] to be reviewed when more detailed topography in this area is obtained.
3. A low flow channel approximately 12' wide, of 3' min. depth to be excavated as shown.
4. Dikes and channel elevations are based on topography as shown on this dwg. Surveyed profiles and sections are required prior to construction to confirm design elevations.

REFERENCE DRAWINGS:
[illegible] Headwaters Diversions - General Arrangement
[illegible] Headwaters Diversion No. 1 - Sections

Scale: A

Klohn Leonoff Consultants Ltd.
CIVIL & GEOTECHNICAL ENGINEERS

Silver Bay, Minnesota RESERVE MINING COMPANY

A-26

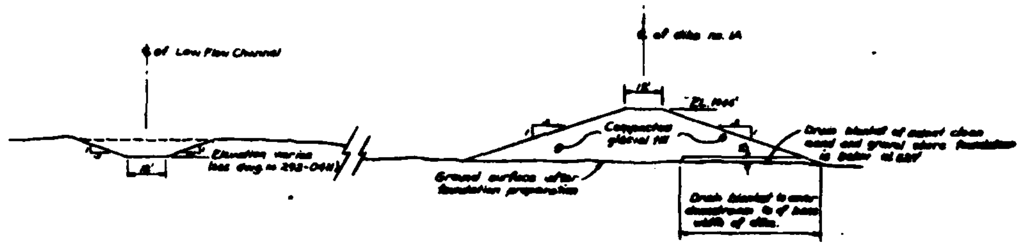
Mile Post No. 7 Site
Tailing Disposal Area
Headwaters Diversion No. 1
General Arrangement

Exhibit 2[illegible]

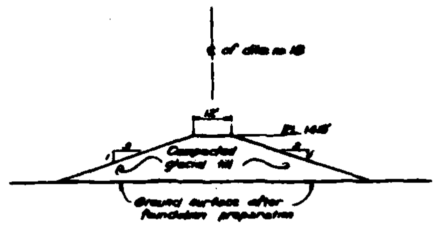
Scale As shown

23

292-0412



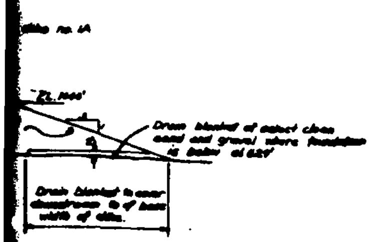
SECTION A-A (Dwg no 292-0411)
Scale: A



SECTION B-B (Dwg no 292-0411)
Scale: A

Preliminary – Issued to Reserve Mining Company

23



NOTES:

1. Dike and channel elevations are based on topography as shown on drawing No. 202-0411. Surveyed profiles and sections are required prior to construction to confirm design elevations.

[illegible]:

202-04[illegible] Headwaters Diversions - General Arrangement

202-0411 Headwaters Diversion No. 1 - General Arrangement

RESERVE MINING COMPANY

Mile Post No. 7 Site

Tailing Disposal Area

Headwaters Diversion No. 1

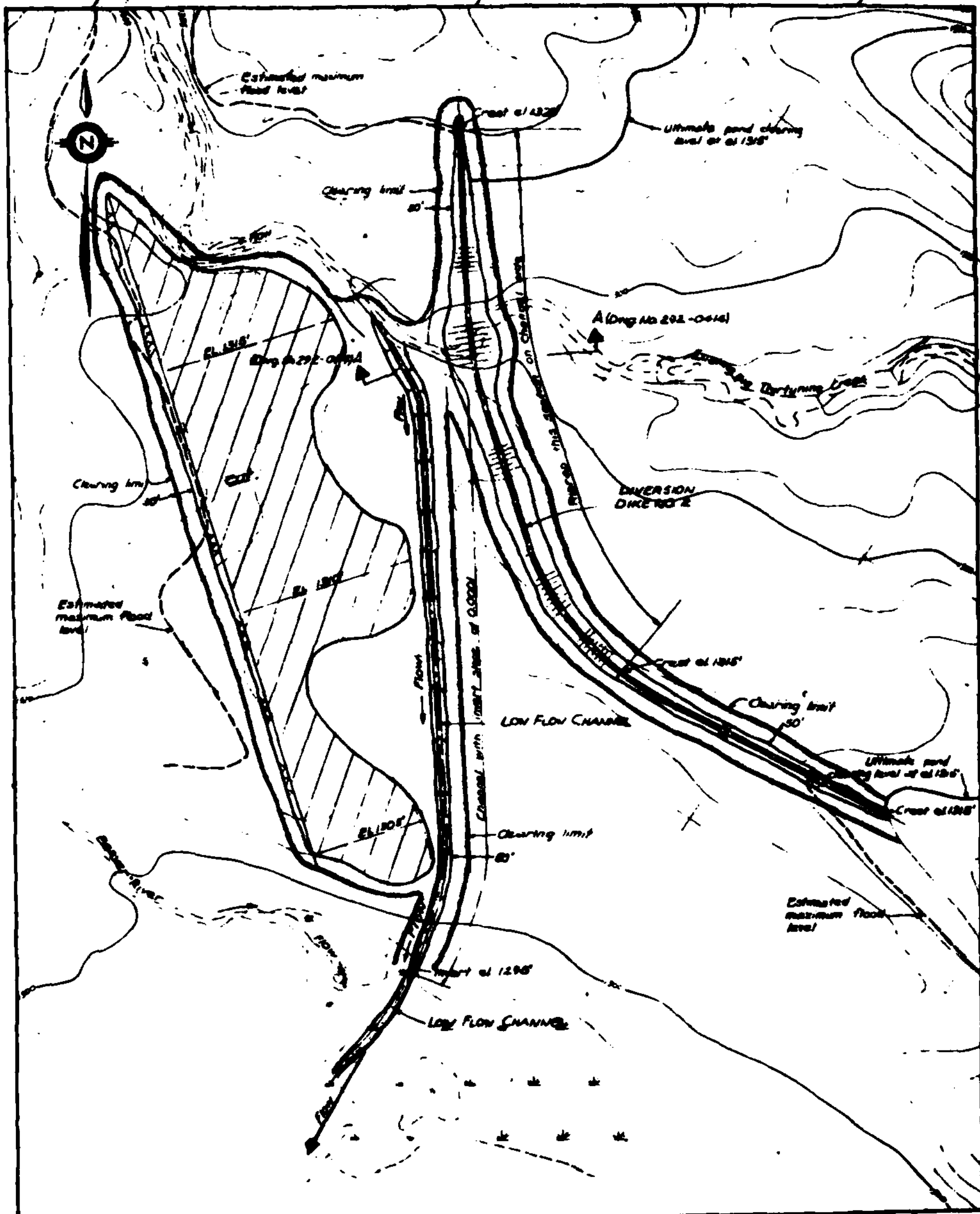
Sections and Details

A-27

Exhibit 27

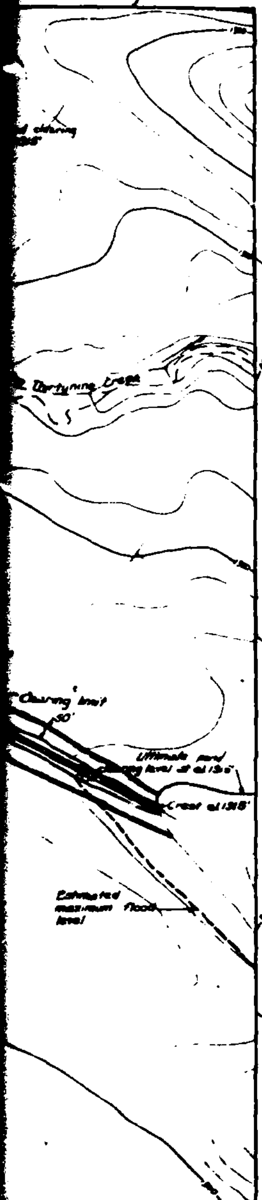
23

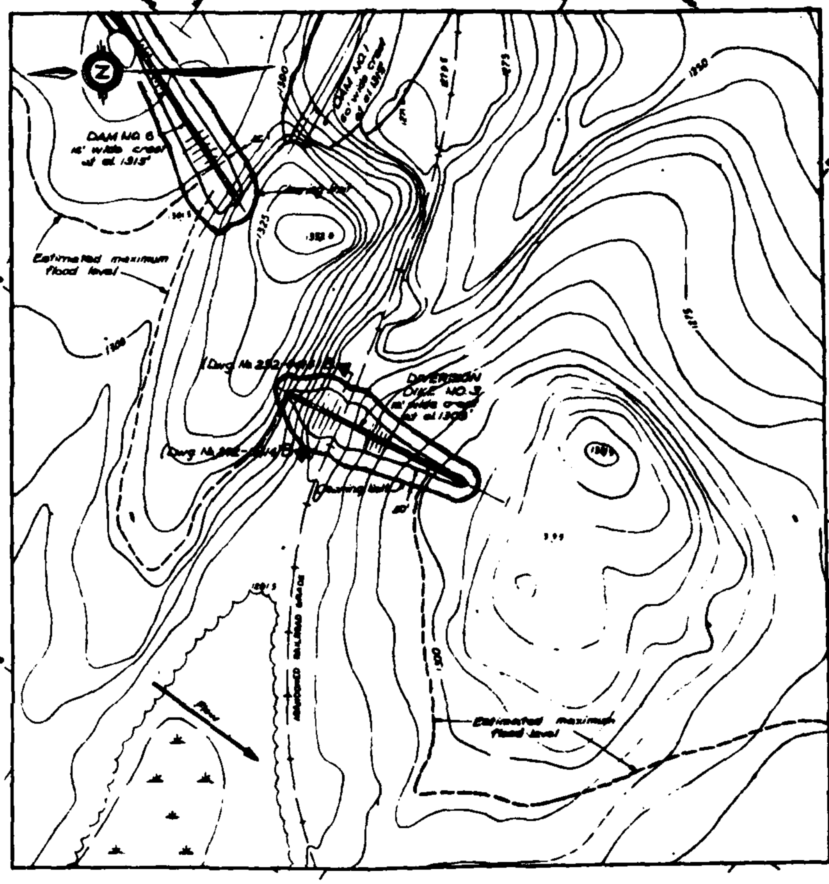
292-0413



LOCATION PLAN
Scale A

–	[illegible]	Preliminary – Issued to Reserve Mining Company
1	[illegible]	Clearing limits added, plug deleted





LOCATION PLAN
Scale : A

NOTES:

1. Maximum flood level based on a flow of 40,000 cfs in the diversion channel.
2. Dike and channel elevations are based on topography as shown on this drawing. Surveyed profiles and sections are required prior to construction to confirm design elevations.
3. A low flow channel approximately 12' wide, 2' min. depth to be excavated as shown.

REFERENCE DRAWINGS:

202-0410 Headwaters Diversions - General Arrangement
202-0414 Headwaters Diversion No. 2 - Sections

Scale : A

Klohn Leonoff Consultants Ltd.
CIVIL & GEOTECHNICAL ENGINEERS

Silver Bay, Minnesota RESERVE MINING COMPANY

A-28

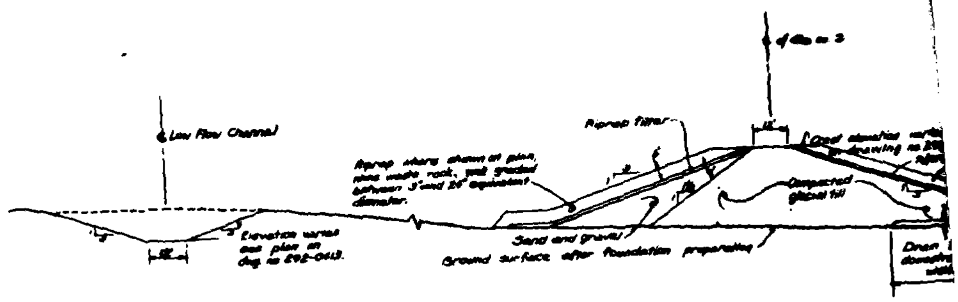
MILE POST No 7 SITE
TAILING DISPOSAL AREA

HEADWATERS DIVERSION No 2
GENERAL ARRANGEMENT

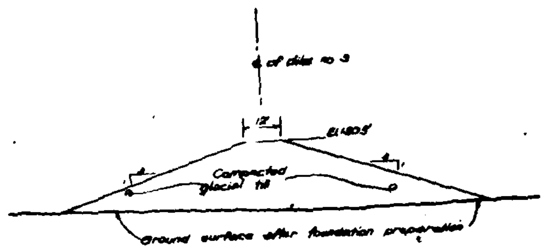
Exhibit

REVISION 1

DIDU-C6C



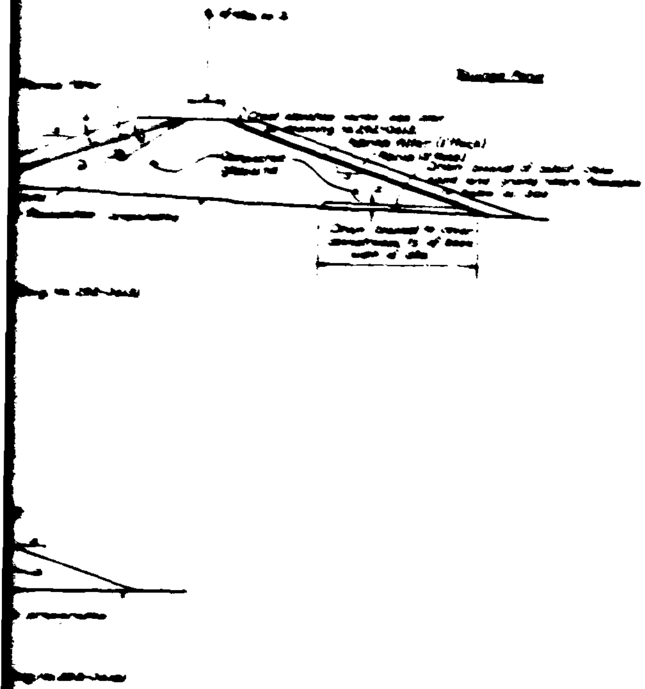
SECTION A-A (Dwg. No. 292-0413)
Scale A



SECTION B-B (Dwg. No. 292-0413)
Scale A

—	[illegible]	Preliminary - Issued to Jameson Mining Company.
1	[illegible]	Plan detail deleted. Section A-A altered.

27



Klohn Leonoff Consultants Ltd.

RESERVE MINING COMPANY

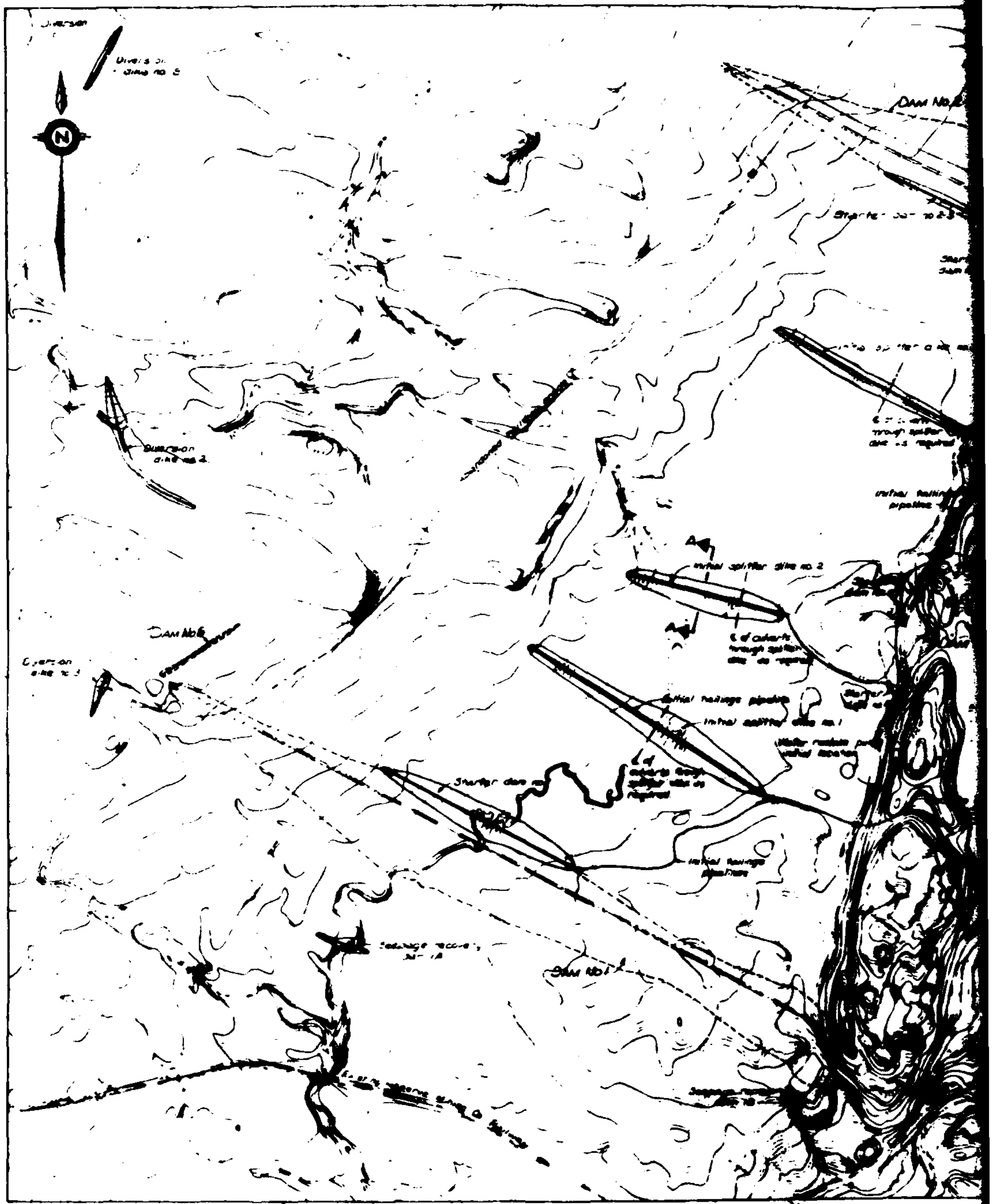
A-29

Mile Post No. 7 Site

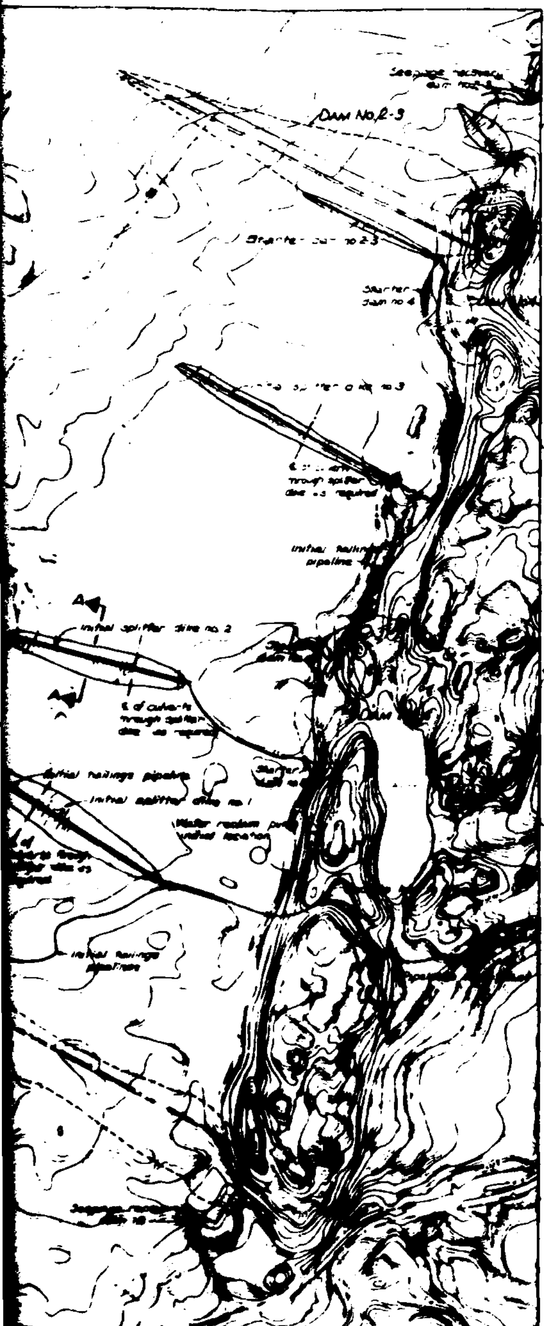
Tailings Disposal Area

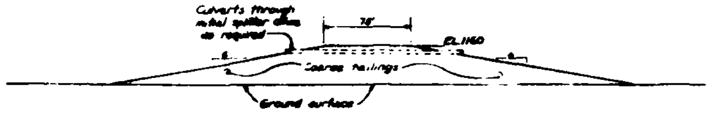
Headwaters Diversion No. 2 Sections

Exhibit 29



LOCATION PLAN
Scale A





SECTION A-A
TYPICAL SECTION THROUGH INITIAL SPLITTER DIKE
Scale B

NOTES:

1. Initially, fine tailings to be spigotted from the splitter dikes and starter dams 1 and 2-3.
2. Culverts to be installed through the splitter dikes as required to maintain equal water levels throughout the pond

REFERENCE DRAWINGS:

292-0120 General layout and location plan
292-0129 Construction ratiug. - general arrangement

Scale: B
Scale: A

Klohn Leonoff Consultants Ltd.
CIVIL & GEOTECHNICAL ENGINEERS

SILVER BAY, MINNESOTA
RESERVE MINING COMPANY

E. Ozorco
A-30

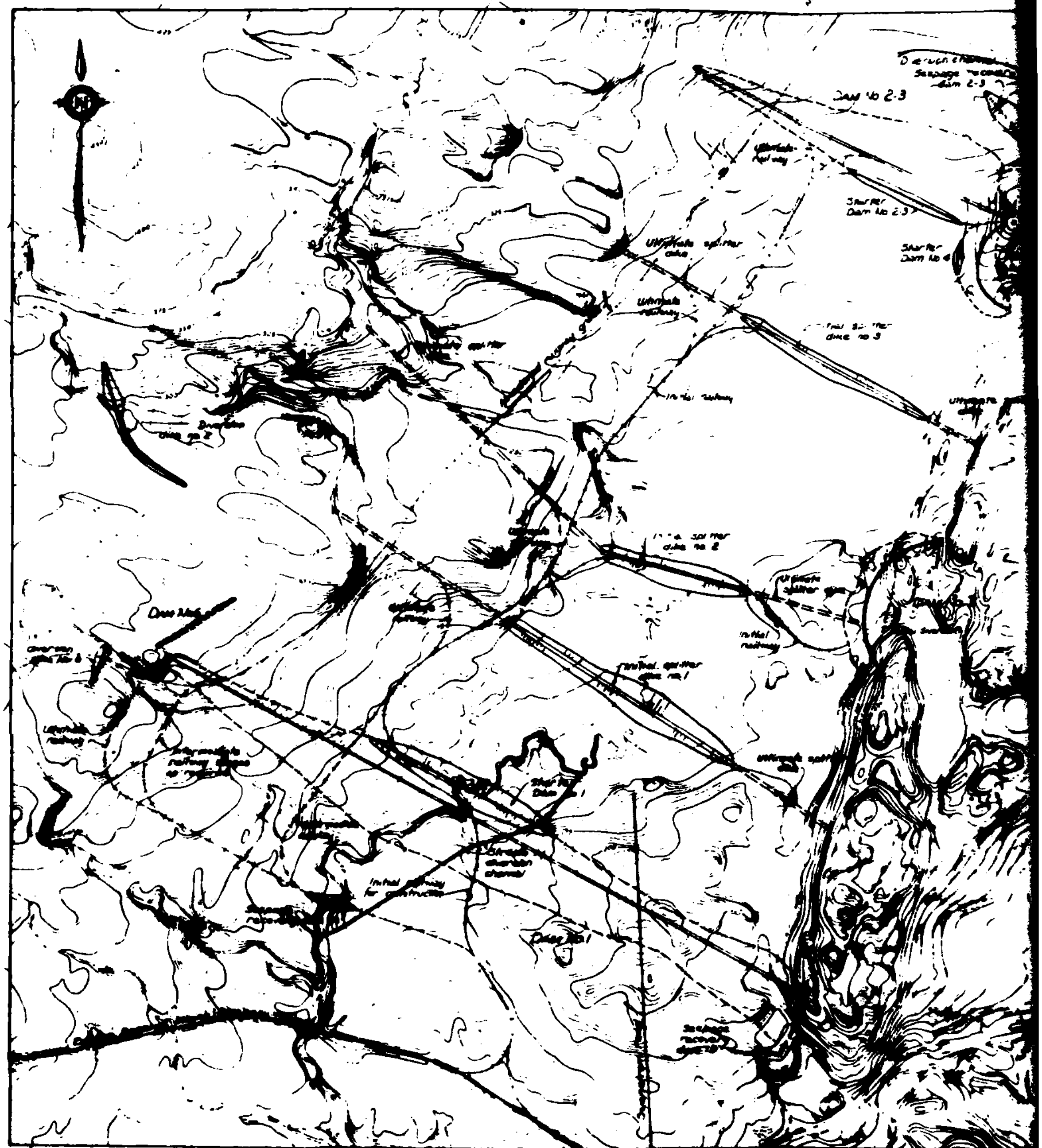
MILE POST NO. 7 SITE
TAILING DISPOSAL AREA
INITIAL FINE TAILINGS
DISCHARGE ARRANGEMENT

Exhibit 30

2 (Sept) 1976

7

292-0129



LOCATION PLAN
Scale A

LEGEND

LEGEND

Initial railway

Ultimate railway

NOTES.

1. Initial railway grade to be constructed of local materials to above elev. 1160 prior to construction of initial splitter dikes. [illegible] in the pond area are to be raised with coarse tailings above the initial grade.
2. Railway locations shown are tentative. Detailed alignment and grades to be assigned by Reserve Mining Co.

REFERENCE DRAWINGS.

292-012C General layout and location plan

292-[illegible] Initial fine tailings discharge arrangement

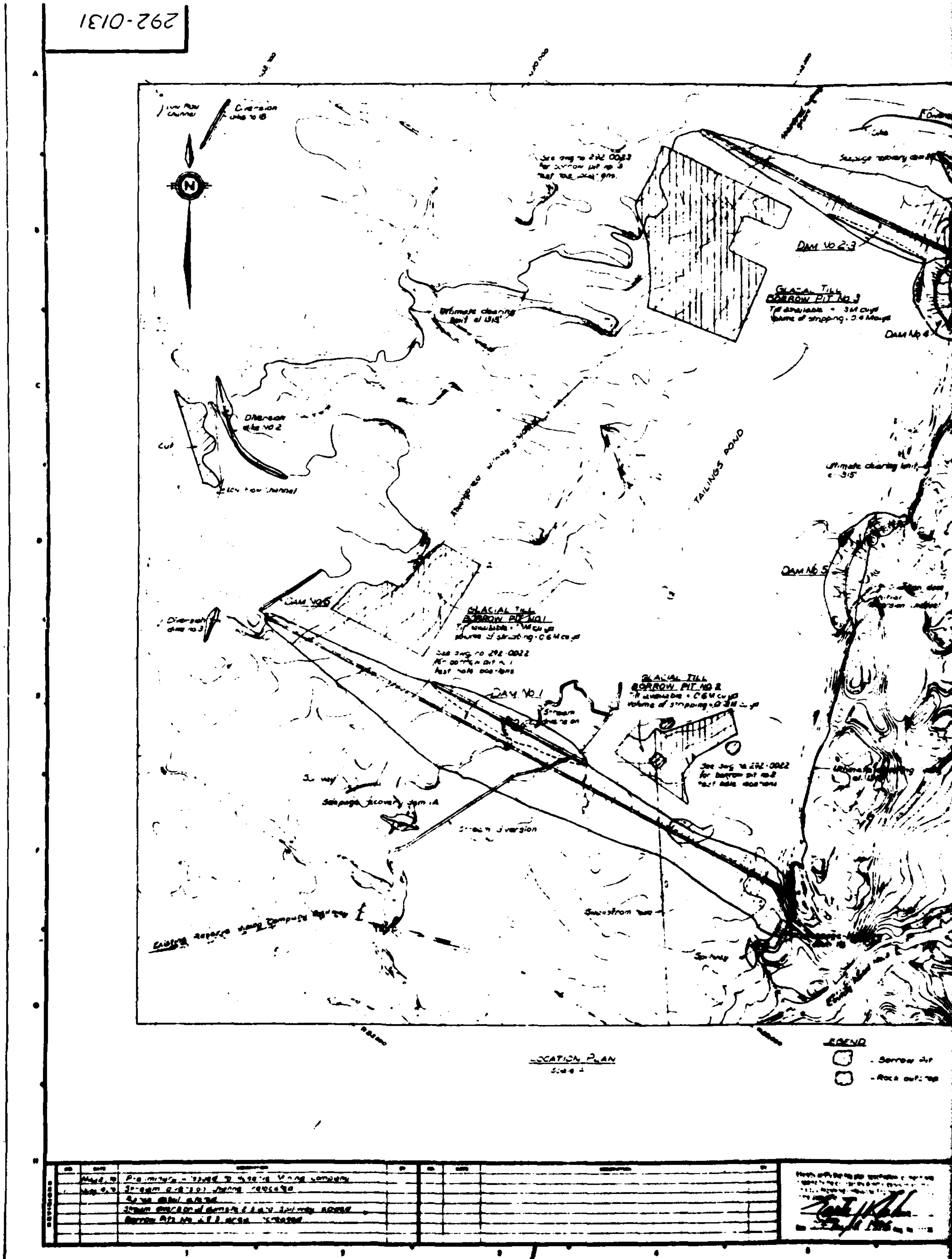
Scale A. 1200

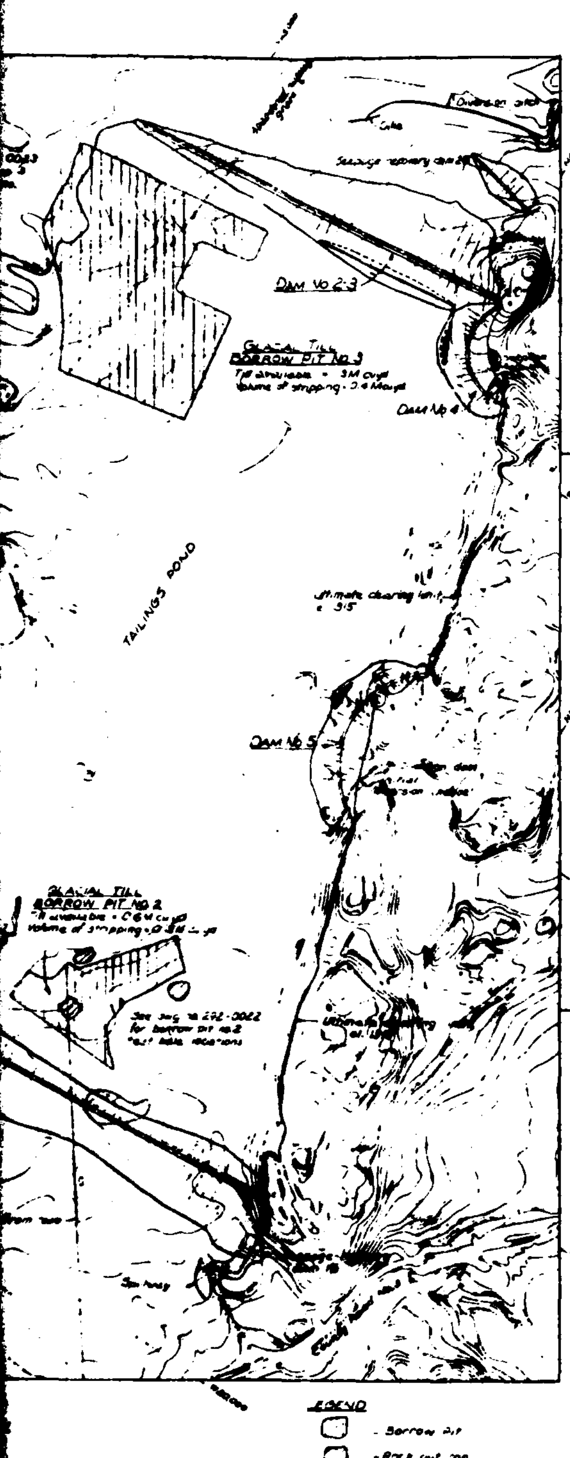
Klohn Leonoff Consultants Ltd.

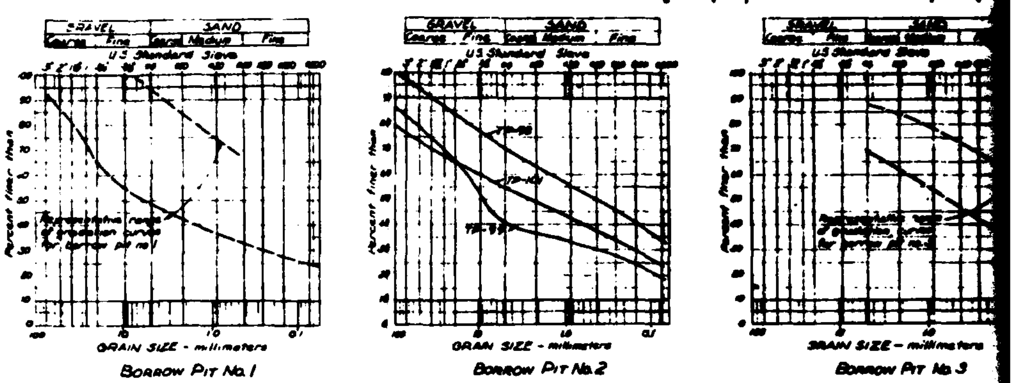
CIVIL & GEOTECHNICAL ENGINEERS

Silver Bay, Minnesota	RESERVE MINING COMPANY	
LCG	Mile Post No. 7 Site	Exhibit 3[illegible]
A-31	Tailing Disposal Area	
Scale As shown	Construction Railway General Arrangement	Revision

2

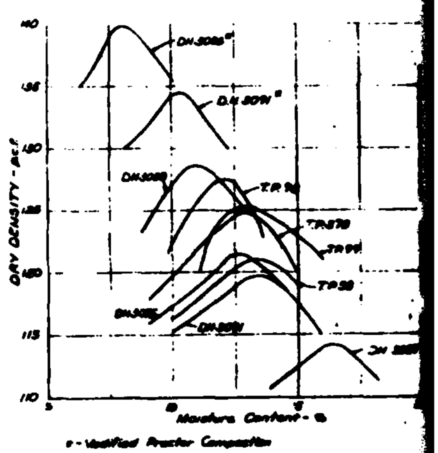

292-0131
N
See dwg no 292-0023 for borrow pit no 3
DAM No 2-3
GLACIAL TILL BORROW PIT No 3
DAM No 4
Ultimate clearing limit el 1315'
Diversion dike No 2
Cut
TAILINGS POND
DAM No 5
DAM No 6
GLACIAL TILL BORROW PIT No 1
See dwg no 292-0022 for borrow pit no 1 test hole locations
DAM No 1
GLACIAL TILL BORROW PIT No 2
See dwg no 292-0022 for borrow pit no 2 test hole locations
Spillway
Seepage recovery dam 1A
Stream diversion
LOCATION PLAN
LEGEND
- Borrow Pit
- Rock outcrop





GLACIAL TILL GRADATION CURVES

TEST PIT OR DRILL HOLE NUMBER	MAXIMUM DRY DENSITY (PCF)	OPTIMUM MOISTURE CONTENT (%)	COMPACTION STANDARD
5B	120	11.4	ASTM D-698-66T Method A (Standard Proctor Compaction)
5C	121	13.3	
90	120	12.0	
95	120	12.8	
101	120	11.9	
3081	125	12.5	
3083	125	12.2	
3087	114	16.6	
3088	129	11.1	
3091	120	13.3	
3095	122	12.5	
3088	140	8.1	ASTM D-1557-66T Method C (Modified Proctor Compaction)
3091	135	10.2	



COMPACTION TEST DATA

APPROXIMATE GLACIAL TILL FILL QUANTITIES REQUIRED

DAM	QUANTITY (C.Y.)	BORROW PIT
DAM 1		
-starter facing	717,000	Borrow No 1 & No 2
-dam facing (above el.1170')	877,000	Borrow No 1 & No 2
DAM 2-3		
-starter	96,000	Borrow No 3
-dam facing (above el.1170')	401,000	Borrow No 3
DAM 4		
-starter	15,000	Borrow No 3
-dam facing (above el.1170')	167,000	Borrow No 3
DAM 5		
-starter	22,000	Borrow No 2 or Locally
-dam facing (above el.1170')	250,000	Borrow No 1 or No 3
S.R. DAM 1-A	44,000	From Diversion Cut
S.R. DAM 1-B	61,000	Borrow No 2
S.R. DAM 2-3	300,000	Borrow No 3

NOTES:

1. Till quantities based on data from test holes as shown on Drawing Nos 292-0022 and 292-0023. Further test holes will be drilled at the time of borrow pit stripping to determine the quantities more accurately.
2. Drainage ditches to be excavated around the perimeter of each borrow pit to control run-off and ground water.

REFERENCE DRAWINGS

292-01... General Layout and Location Plan

Scale: 1" = 1000'

Klohn Leonoff Consultants Ltd.
CIVIL & GEOTECHNICAL ENGINEERS

SILVER BAY, MINNESOTA RESERVE MINING COMPANY

A-32

MILE POST No. 7 SITE
TAILING DISPOSAL AREA
BORROW PITS -
LOCATIONS & ESTIMATED VOLUMES

Exhibit

292-0140

Glacial fill placement season (Typical) | Season of no fill placement (Typical)

ITEM	UNIT	APPROX QUANTITY INITIAL	APPROX QUANTITY TOTAL	Schedule annotation
HIGHWAYS & ROADS				
Road to Dam 1	Miles	2.4		
Rd. to headwaters Diversions	Miles	3.9		
Road to Dam 2-3	Miles	1.3		
Construct Railway to:				
Dam 1				
Dam 2-3				
Dam 4				
Dam 5				
STREAM DIVERSIONS				
Headwaters Diversions 1 & 2				
Dam No. 1				
Seepage Recovery Dam 2-3				
Bear Lake				
Coffer dam ([illegible])				
CLEAR				
Tailings Pond	Acres	1820	3700	
BORROW PIT DEVELOPMENT				
Gravel Pit				
Glacial Till Pits				(initial)
TAILINGS DAMS				
DAM NO. 1				
Clearing	Acres	180	411	(starter dam)
Foundation Preparation	Acres	188	381	(starter dam)
Instrumentation				
Test Fill - Glacial Till	C.Y.	58,000		
Test Fill - Sand & Gravel	C.Y.	18,000		
Starter Dam - Glacial Till	C.Y.	817,000		(stockpile)
Starter Dam - Sand & Gravel	C.Y.	338,000		
Horizontal Filter	C.Y.	465,000	970,000	
Horizontal Drain	C.Y.	687,000	1,514,000	
Coarse Tailings	C.Y.	6,178,000	34,499,000	
Fine Filter	C.Y.		865,000	
Glacial Till Facing (above 1170)	C.Y.		877,000	
Rip Rap Filter	C.Y.	16,900	158,900	
Rip Rap	C.Y.	36,600	478,300	
Grouting				
DAM NO. 2 & 3				
Clearing	Acres	64	158	
Foundation Preparation	Acres	63	145	
Instrumentation				
Starter Dam	C.Y.	36,000		
Horizontal Filter	C.Y.	160,000	380,000	
Horizontal Drain	C.Y.	244,000	592,000	
Coarse Tailings	C.Y.		12,044,000	
Fine Filter	C.Y.	–	392,000	
Glacial Till Facing	C.Y.		401,000	
Rip Rap Filter	C.Y.	4,800	68,800	
Rip Rap	C.Y.	14,400	241,700	
Grouting				
DAM NO. 4				
Clearing	Acres	3	36	
Foundation Preparation	Acres	3	31	
Starter Dam	C.Y.	16,000		
Horizontal Filter	C.Y.		68,000	
Horizontal Drain	C.Y.		118,000	
Coarse Tailings	C.Y.		1,755,000	
Fine Filter	C.Y.		161,000	
Glacial Till Facing	C.Y.		167,000	
Rip Rap Filter	C.Y.	500	28,000	
Rip Rap	C.Y.	1,400	83,000	
Grouting				
DAM NO. 5				
Clearing	Acres	12	53	
Foundation preparation	Acres	12	48	
Starter Dam	C.Y.	22,000		
Horizontal Filter	C.Y.	35,000	112,000	
Horizontal Drain	C.Y.	32,000	180,000	
Coarse Tailings	C.Y.		3692,000	
Fine Filter	C.Y.		248,000	
Glacial Till Facing	C.Y.		286,000	
Rip Rap Filter	C.Y.	300	43,400	
Rip Rap	C.Y.	1,400	129,700	
Grouting				
SEEPAGE RECOVERY DAMS				
SEEPAGE RECOVERY DAM 1A				
Coffer Dam				(initial)
Clearing	Acres	38		(final)
Foundation Preparation	Acres	3.3		
Instrumentation				
Embankment	C.Y.	44,000 (4... [illegible])		
Recovery Pump System				
SEEPAGE RECOVERY DAM 1B				
Clearing	Acres	12		
Foundation Preparation	Acres	3		
Embankment	C.Y.	61,000		
Recovery Pump System				
Grouting				
SEEPAGE RECOVERY DAM 2-3				
Clearing	Acres	31		
Foundation Preparation	Acres	10		
Embankment	C.Y.	262,000		
Recovery Pump System				
SEEPAGE RECOVERY DAM 4				
Complete System	(Before Design [illegible] ... Return of Flow)			
SEEPAGE RECOVERY DAM 5				
Recovery Pump System				
WATER RECLAIM SYSTEM				
Complete System				
TAILING DISCHARGE				
Saddle Dikes (elev. 1180')	C.Y.	1,504,000		

Schedule columns: MAY-JUNE 2, JULY-AUG 4, SEPT-OCT 6, NOV-DEC 8, JAN-FEB 10, MAR-APR 12, MAY-JUNE 14, JULY-AUG 16, SEPT-OCT 18, NOV-DEC 20, JAN-FEB 22, MAR-APR

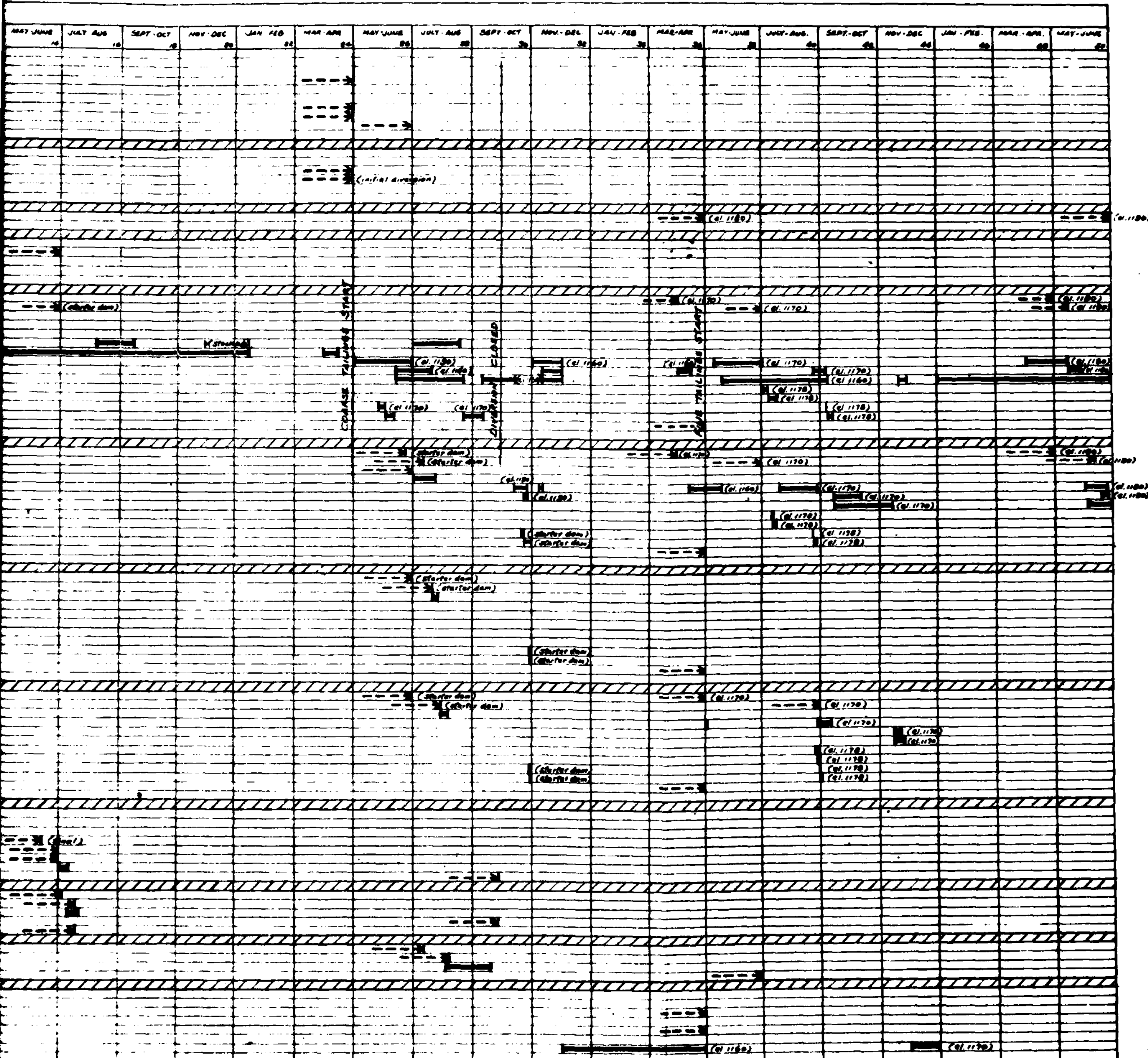
NOTES:

1. This schedule is tentative only and is to indicate the sequence of steps necessary to construct the tailings dams. The schedule is to be used only as a guide to construction and is not to be considered a program to be rigidly adhered to.
2. Initial quantities refer to construction to be completed prior to the start of fine tailings deposition (month 37). Some items not shown to be completed after that date i.e. Dam No. 5

LEGEND

- - - - ■ Item must be completed by this time

▬▬▬ Estimated period for completion



LEGEND

Item must be completed by this time

Estimated period for completion

Klohn Leonoff Consultants Ltd.

SILVER BAY, MINNESOTA

RESERVE MINING COMPANY

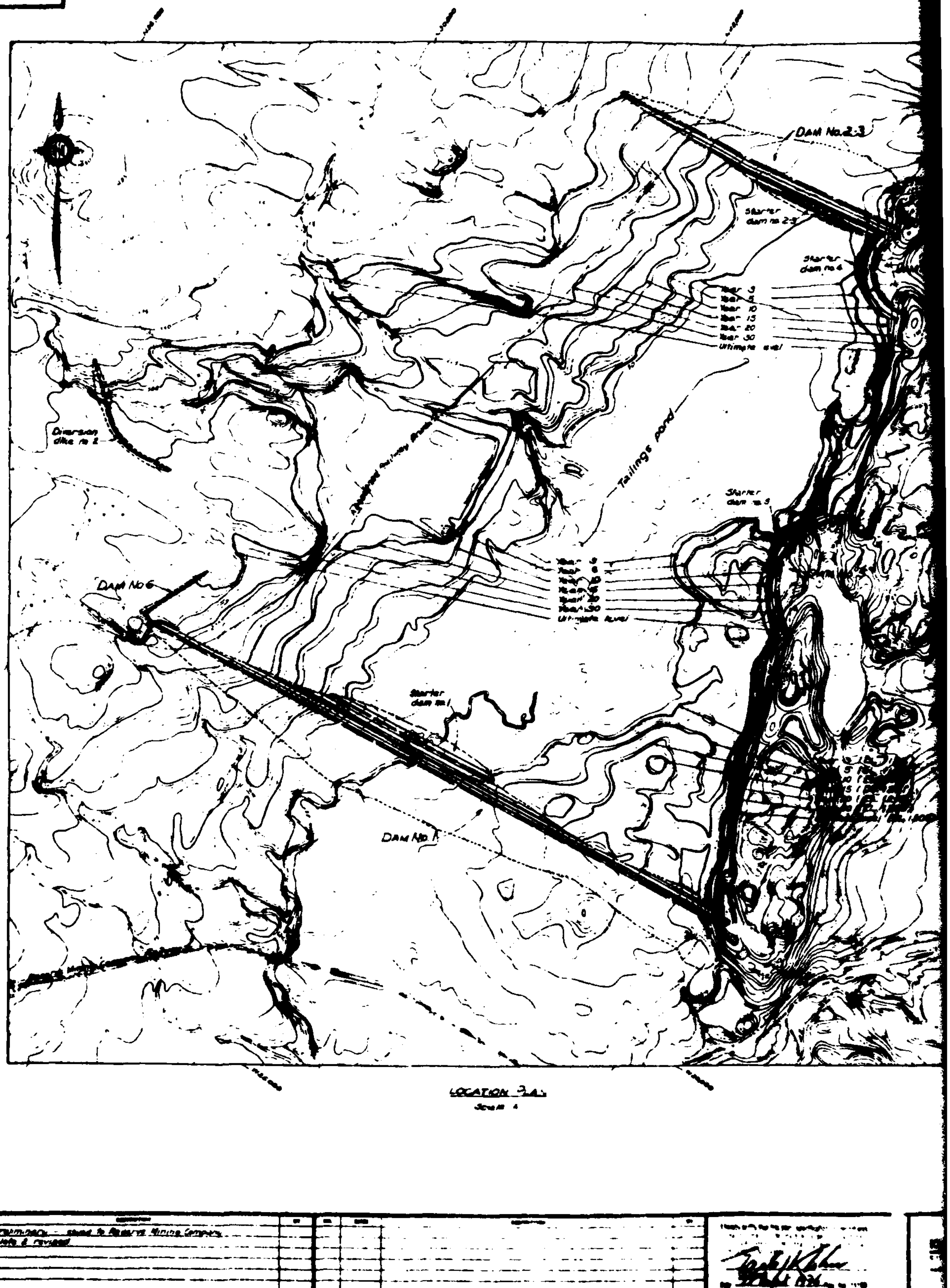
J. Kon

A-33

MILE POST NO. 7 SITE
TAILING DISPOSAL AREA

TENTATIVE
CONSTRUCTION SCHEDULE

Exhibit



LOCATION PLAN

Scale

No.	Date	Description
	[illegible]	Preliminary — issued to Reserve Mining Company
1	[illegible]	Note 8 revised

NOTES:

1. The pond levels on this drawing are the design pond levels as shown on Drawing No. 292-C18C.
2. Times shown refer to May ... year 3 (Approval for construction).

REFERENCE DRAWINGS

292-C12	General Layout and Location Plan
292-C132	Clearing Limits
292-C180	Volume Design Curves - Pond Volume, Area and Filling Rate.

Scale

Klohn Leonoff Consultants Ltd

SILVER BAY, MINNESOTA

RESERVE MINING COMPANY

DAM SITES

A-34

MILE POST No 7 SITE
TAILING DISPOSAL AREA

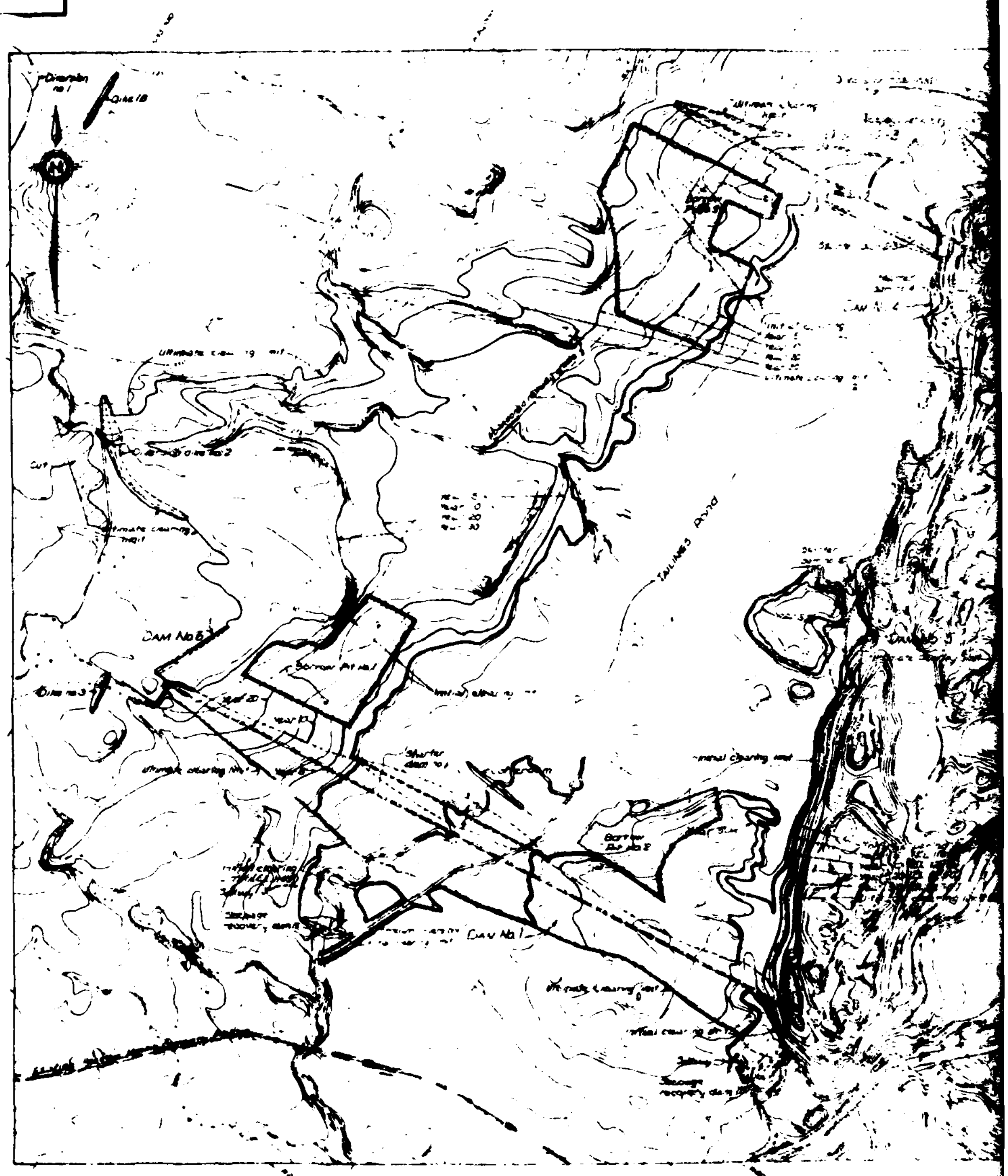
TAILINGS POND
EXTENT WITH TIME

Exhibit 34

REVISION

2

292-0132


Diversion No 1
Dam No 3
Borrow Pit No 1
Tailings Pond
Dam No 1
Borrow Pit No 2

22

NOTES

1. Initial clearing limit shown includes all areas required to be cleared prior to start of fine tailings deposition. This area includes starter dams, seepage recovery dams, tailings pond to elev. 1180, and diversion dike and channel areas.
2. Times shown refer to May 1, year 0 (Approval for construction).
3. Clearing elevations to be 10 ft. vertically above the design pond level at any time.
4. Clearing for stream diversions to be included [illegible] clearing. For clearing limits see drawings 292-3411 and 29[illegible]-3413.

REFERENCE DRAWINGS

292-0120	General Layout and Location Plan
292-0133	Tailings Pond - Extent With Time
292-0200	Damsite No. 1 - General Arrangement
292-0250	Damsite No. 2-3 - General Arrangement
292-0300	Damsite No. 4 - General Arrangement
292-0350	Damsite No. 5 - General Arrangement
292-0400	Damsite No. 6 - General Arrangement

Scale A

Klohn Leonoff Consultants Ltd.

SILVER BAY MINNESOTA

RESERVE MINING COMPANY

DAM SITES

DRAWN L.C.G.

SCALE As shown

A-35

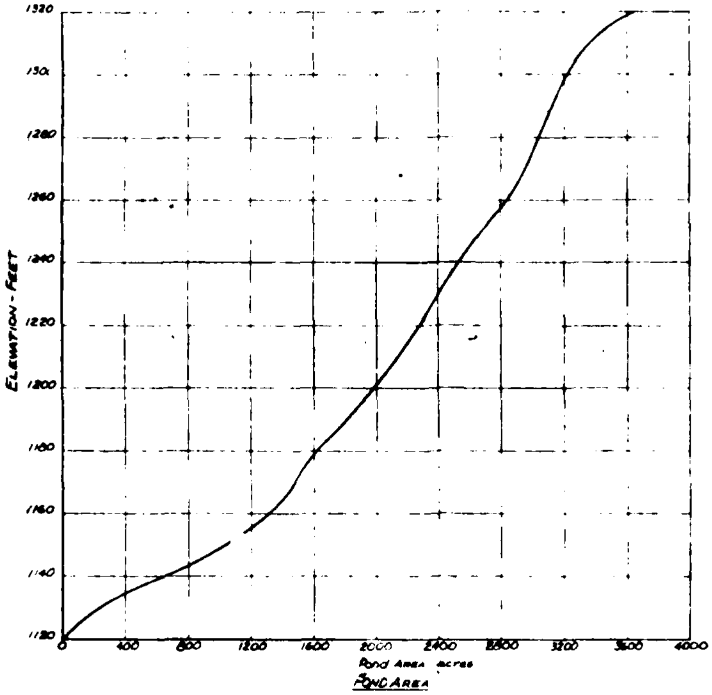
MILE POST No 7 SITE
TAILINGS DISPOSAL AREA

CLEARING LIMITS

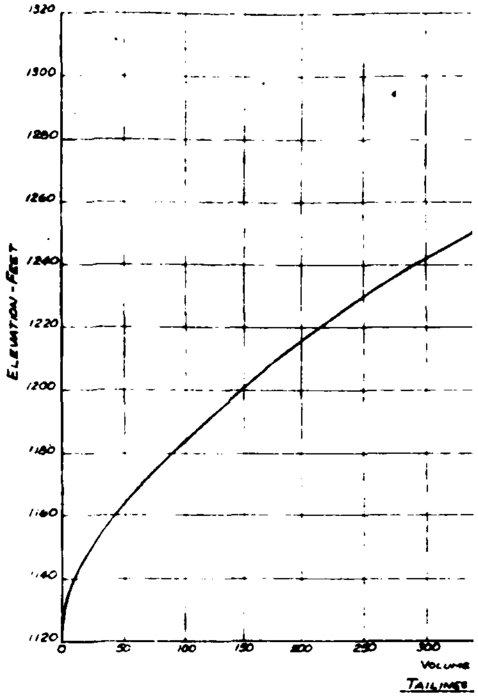
Exhibit 35

REVISION 1

2



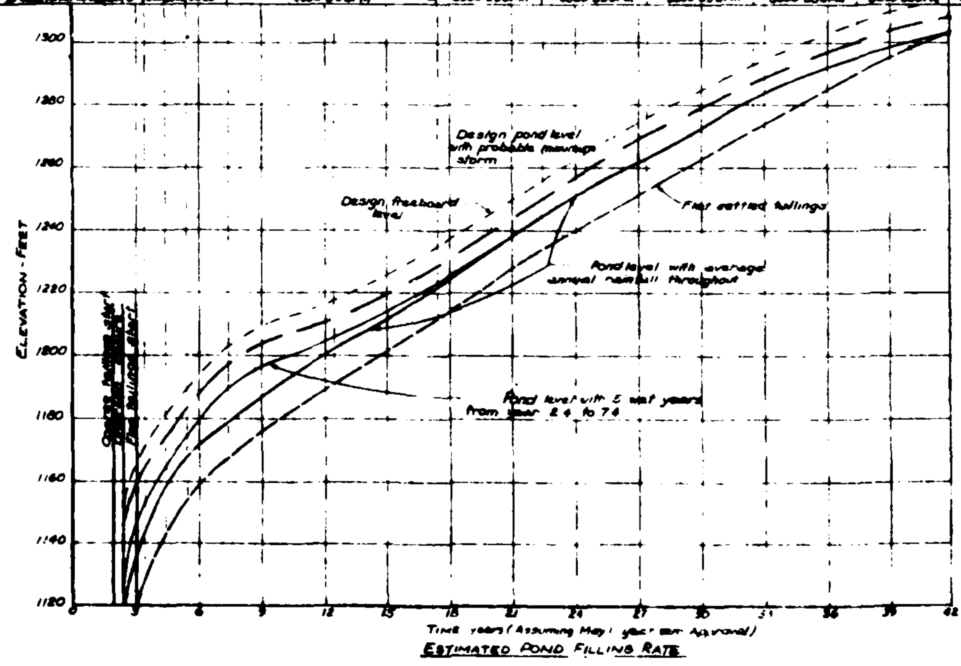
POND AREA



TAILINGS

Assumed Reclaim Pumping Rate

									Average Rate
Design pond level	0	4000 USGPM	5000 USGPM	3800 USGPM	3000 USGPM	4000 USGPM	3200 USGPM	8000 USGPM	4040 USGPM
Avg. precipitation through[illegible]	0	[illegible] 3000 / 4500 USGPM		3000 USGPM	4000 USGPM	2800 USGPM	3000 USGPM	6000 USGPM	4277 USGPM



ESTIMATED POND FILLING RATE

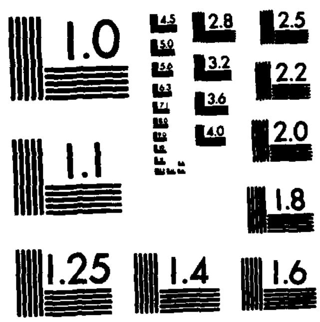
No.	Date	Description
—	May '76	Preliminary - Issued to Reserve Mining Company
1	Aug. '76	Notes revised. Design freeboard level and pond level with 5 wet years from yr 2.4 to 7.4 curves added.

AD-A121 454 POWER PLANT DISCHARGE STRUCTURE DELTA STABILIZATION DIKE AND ON-LAND TACO..(U) CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT MAR 77

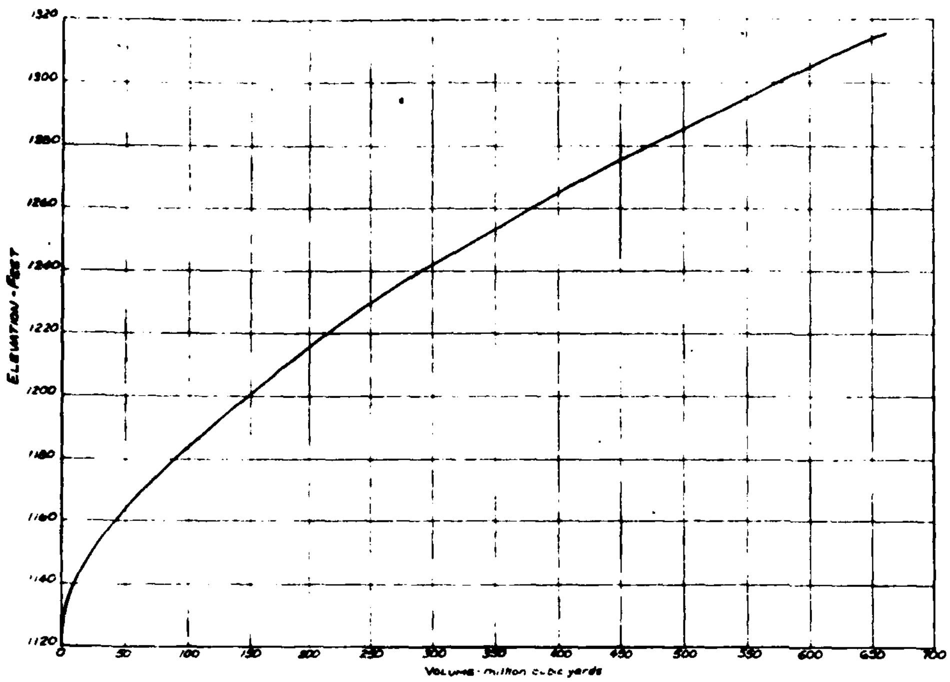
4/4

UNCLASSIFIED F/G 13/2 NL

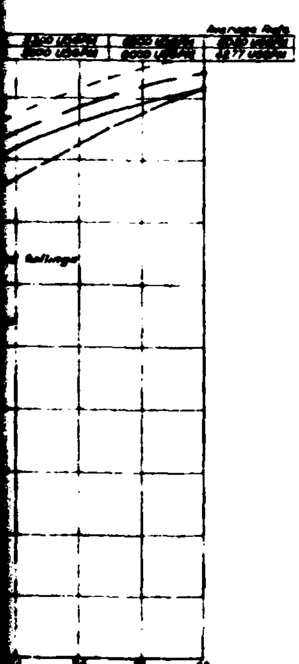
END
DATE
FILMED
DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



Tailings Pond Capacity



NOTES:

1. Times shown refer to May 1, year 0 (Approval for construction).
2. Coarse tailings construction assumed to start at month 24. Diversion through Dam 1 assumed to be closed on Sept. 30, month 30. Fine tailings production assumed to start on May 1, month 37
3. The flat settled tailings level is based on
   - a) Fine tailings rate of 920,577 C.Y./Month for 12 mo./yr.
   - plus b) Coarse tailings rate of 468,017 C.Y./Month for 6 mo./yr. until year 10.3 then 12 mo./yr. until year 42. (Coarse tailings used for dam construction for 6 months per year up to year 10.3.)
4. The design pond level is the cumulative sum of:
   - a) Settled tailings (coarse and fine).
   - plus b) Net runoff from a 5 year wet period (years 2.6-7.6) of 10,000 years recurrence interval.
   - plus c) Net runoff from average annual precipitation (years 7.6-42)
   - plus d) Runoff from a maximum probable storm, assumed to occur once, at any time, during the 39.6 year period of pond filling.
   - plus e) Fine tailings transport water.
   - less f) Volume of voids in coarse and fine tailings in pond.
   - less g) Reclaimed water returned to plant.
5. Maximum reclaim rate assumed to be 6000 U.S. G.P.M., actual reclaim rate will vary.

REFERENCE DRAWINGS:

290-0140	Construction schedule
292-0160	Tailings storage dams - construction staging
292-0181	Tailings Dams Construction Volumes

Klohn Leonoff Consultants Ltd.

CIVIL & GEOTECHNICAL ENGINEERS

Silver Bay, Minnesota

RESERVE MINING COMPANY

A-36

Mile Post No 7 Site

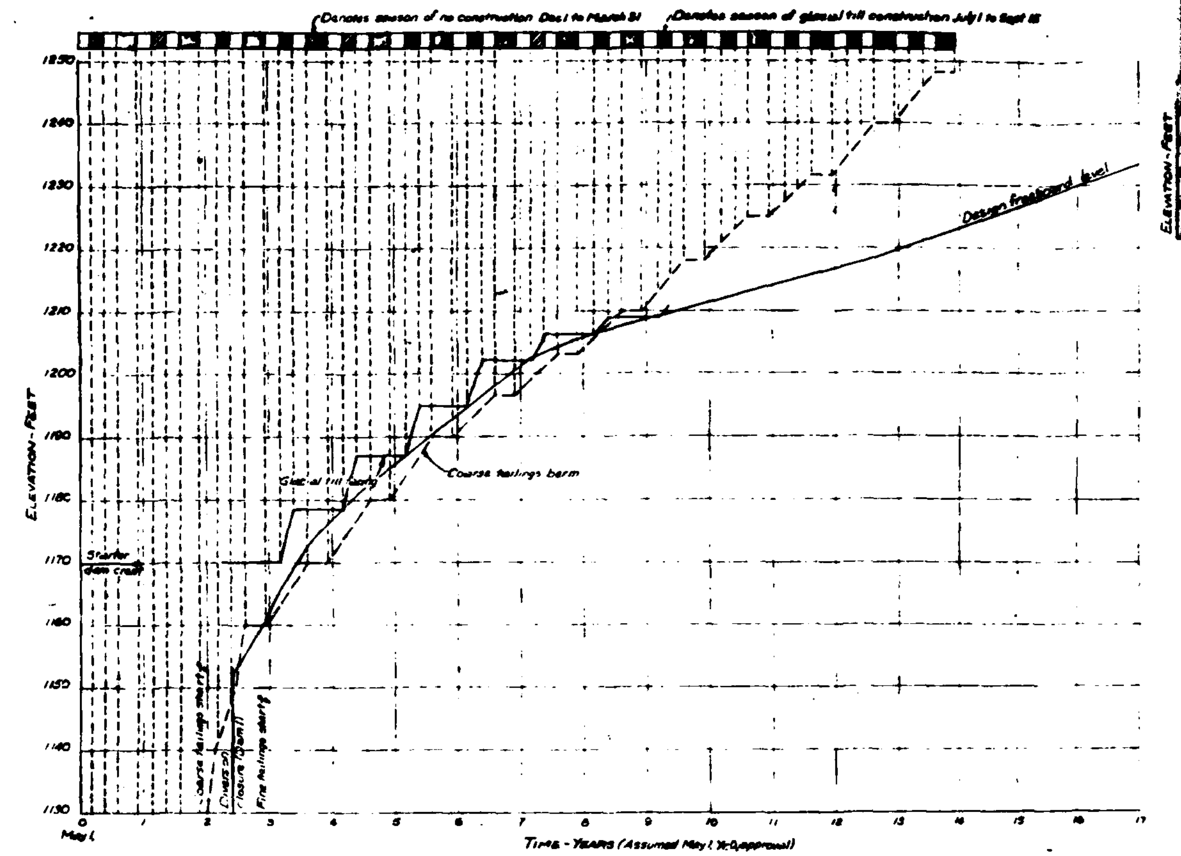
Tailing Disposal Area

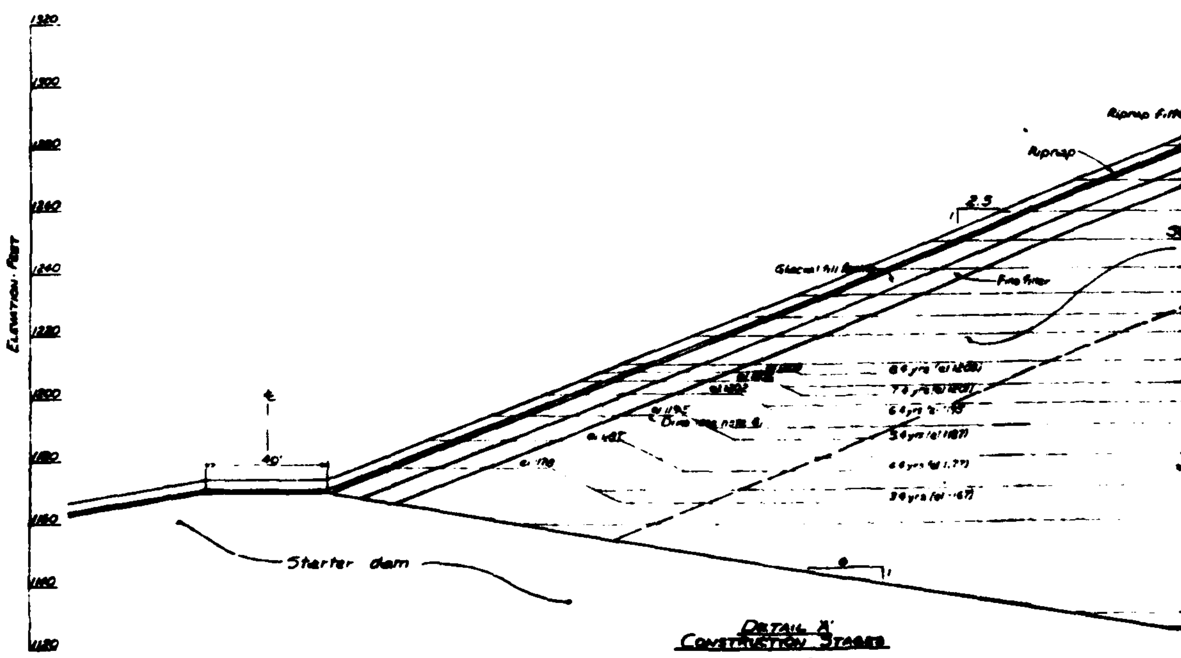
Volume Design Curves

Pond Volume, Area & Filling Rates

Exhibit

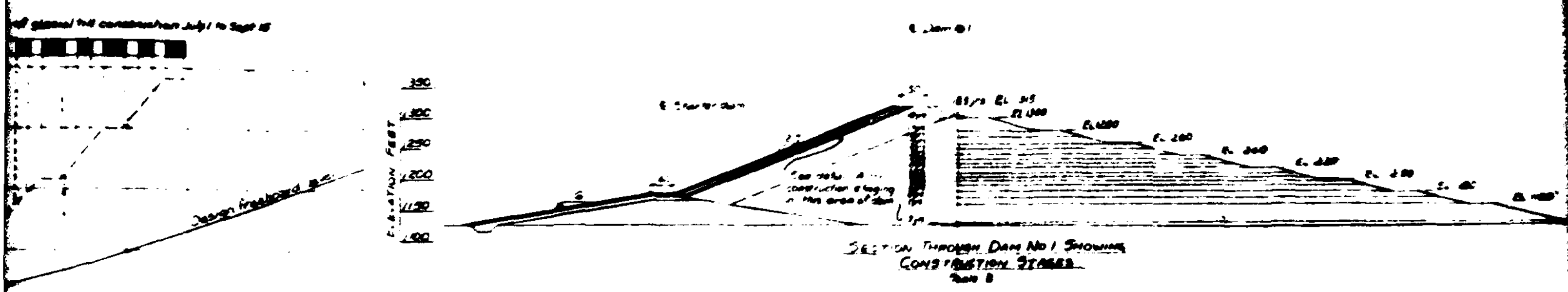
292-0160

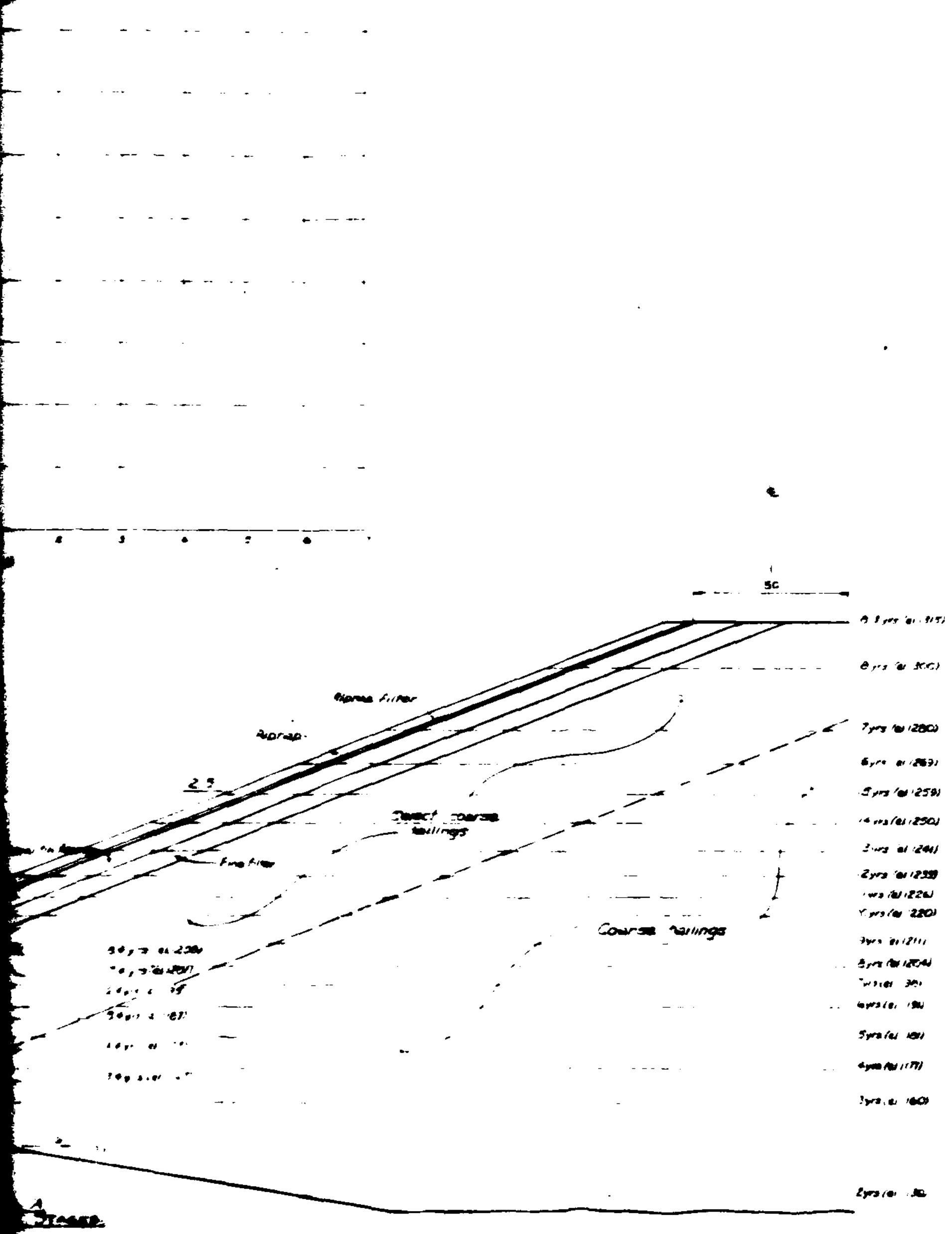




DETAIL 'A'
CONSTRUCTION STAGES
Scale A

No.	Date	Revision
–	[illegible]	Preliminary - Issued to Reserve Mining Company
1	[illegible]	Riprap detail revised
		Select coarse tailings zone widened, dike levels altered, notes revised





NOTE:

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible] each year.
5. [illegible] possible rate.
6. Design pond level is the cumulative sum of -
   a. [illegible]
   [illegible]

[illegible]

Scale B
Scale A

RESERVE MINING COMPANY

MILE POST No 7 SITE
TAILING DISPOSAL AREA

TAILINGS STORAGE DAMS
CONSTRUCTION STAGING

A-37

Scale AS SHOWN

Exhibit

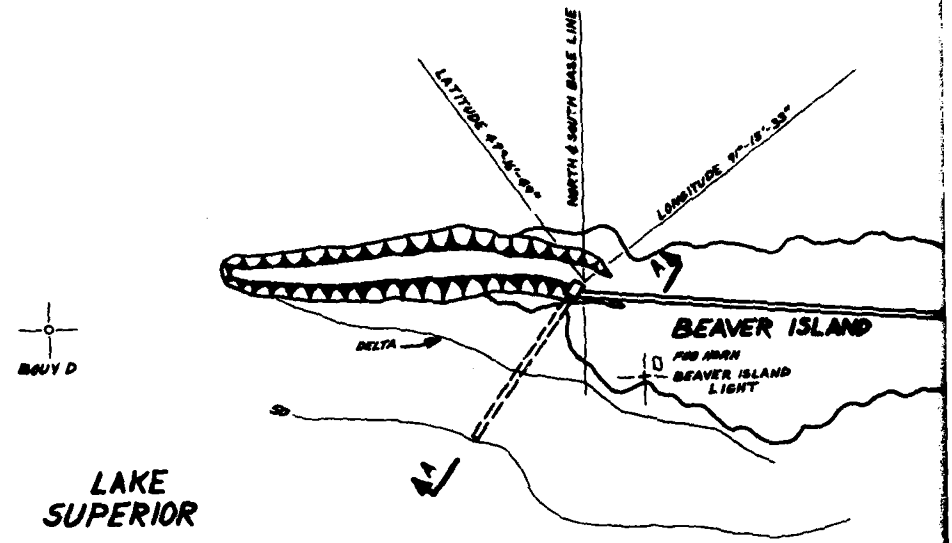
Klohn Leonoff Consultants Ltd.

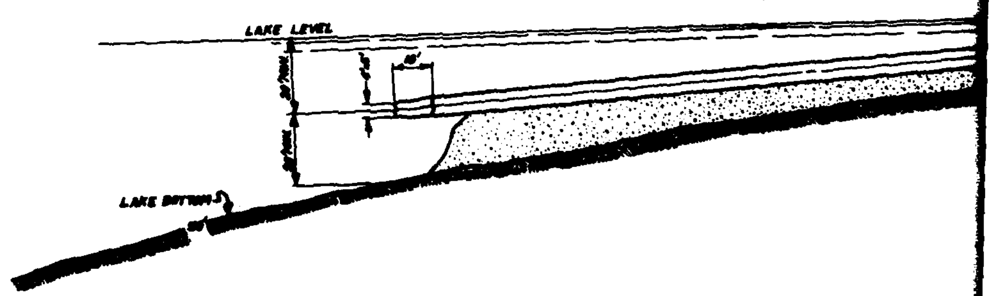
REVISION 1

1

2

Proposed Discharge Pip

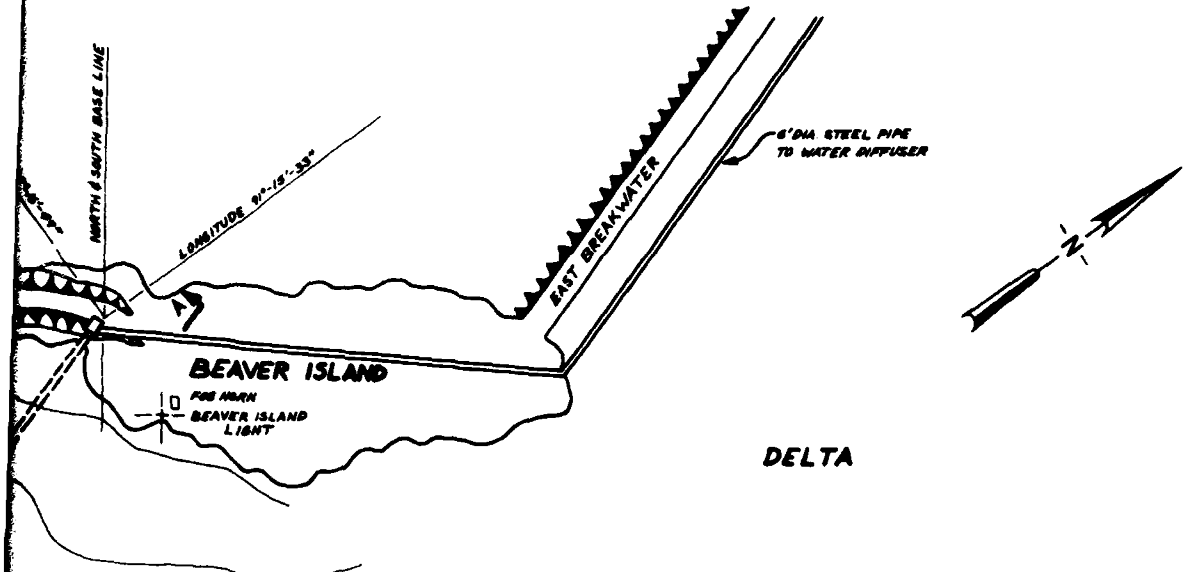




1

23

posed Discharge Pipe and Diffuser



SECTION A-A

Thermal Plume Calculations

Reserve will discharge its cooling water below the surface to take maximum advantage of momentum entrainment and turbulent diffusion to dissipate excess temperature. This minimizes the size of the plume and, therefore, the effect on the aquatic life in the lake. The actual dimensions of the discharge plume are calculated based on the mathematical model by Dr. Donald W. Pritchard.* This model is based on laboratory and field studies of actual discharges in both deep and shallow water. The comparison of the predicted and observed dimensions and areas of the plumes studied was reasonably good, and strongly suggest that any error in the predicting model is on the conservative side. The details of plume calculation basis are described next.

Thermal Plume Calculations: Reserve's thermal plume calculations use a mathematical model developed by Dr. Donald W. Pritchard,* of Johns Hopkins University, a renowned authority on thermal plumes. Reserve has retained Dr. Pritchard as a consultant, and he has verified Reserve's calculations.

Basically, the model is based on laboratory and field studies and indicates that the following general equation holds:

$$\zeta_\theta = n\sqrt{b_o h_o}\left(\frac{\theta}{\theta_o}\right)^{-\beta}$$

Where: ζ_θ → horizontal length of plume centerline to any isotherm

b_o → horizontal dimension of orifice

h_o → vertical dimension of orifice

θ → excess temperature at a given distance from orifice

Θ_0 → excess temperature at point of discharge

n&β are experimentally derived coefficients which are dependent on environmental and discharge parameters.

*"The Fate and Effect of Excess Heat Discharged into Lake Michigan with Specific Application to the Condenser Cooling Water Discharge from the Zion Nuclear Power Station," prepared by Dr. Donald W. Pritchard.

Thermal Plume Calculations (con't)

The maximum width of any isotherm (b_θ) is given by the equation:

$$b_\theta = b_o + m\,\zeta_\theta$$

Where: m is a constant which is dependent on various environmental and discharge parameters, and b_o is the horizontal dimension of the orifice.

The calculation of the time of exposure within the plume is based on the assumption that excess momentum varies the centerline of the plume in the same way as excess temperature, or:

$$\frac{q_\zeta}{q_0} = \frac{\theta_\zeta}{\theta_0}$$

The velocity at any isotherm (q_ζ) can be calculated. The time of exposure to excess temperature equal to or greater than θ is given by:

$$\tau_\theta = \sum_{i=o}^{m} \left(\frac{\Delta\zeta_i}{\bar{q}_i}\right) \qquad \text{Where}$$

$\Delta\zeta_i$ = the difference in the distances along the plume centerline to the θ_i and θ_{i-1} isotherms.

$$\bar{q}_i = \left[1/2\left(\frac{1}{q_i} + \frac{1}{q_{i-1}}\right)\right]^{-1}$$

The predictive model generally described above has been applied to the Reserve Mining Company power plant discharge.

The following assumptions were made in this application:

1. The calculations are carried out for an un-bent jet, i.e., there is minimal interaction from along-shore currents or from buoyant forces.
2. The plume does not interact in any way with the shoreline or the bottom.

Reserve Mining Company Power Plant Plume Calculations

Case #1 - Ambient lake water temperature = 65°F. Assume no recirculation $\therefore$ discharge excess temperature (θ_0) = 12°F. Assume downstream current ≈0.

$$\rho_{H_2O}^{77°} \equiv 62.240$$

$$\therefore \Delta\rho = 0.10 \ \& \ \Delta\rho/\rho \equiv \frac{0.10}{62.34} \equiv 0.001604$$

$$\rho_{H_w}^{65°} \equiv 62.340$$

$$\therefore \ F_0 \equiv \frac{q_o}{\sqrt{g(h)\Delta\rho/\rho}} \equiv \frac{12}{\sqrt{(32.21)(4)(0.001604)}} \equiv 26.3961$$

$$\therefore \ n = 7.57-3.638\ (26.3961)^{-0.245} \equiv 5.9385$$

$$A_r = ho/bo = 4'/5' \equiv \underline{0.80} \ \& \ \beta = A_r^{-f_1(F_0)} \cdot \beta'$$

$$\text{Where } \beta' = 1.000 + [3.684/(F_0) - 6.524/(F_0)^2 + 5.840/(F_0)^3]$$

$$\therefore \beta' \equiv \underline{1.1299}, \text{ and}$$

$$f_1(F_o) = [1/3\ (26.3961) + 5]^{-1} \equiv \underline{0.0725}$$

$$\therefore \beta = (0.80)^{-0.0725} \cdot (1.1299) \equiv (1.0163)(1.1299) = 1.1483$$

$$m(F_0) = 1/n \left[1.052 + (3.945)^{-F_0/10} - (2.999)^{-2\ F_0/10} - (1.933)^{-3\ F_0/10} \right]$$

$$= 1/(5.9385) \left[1.052 + (3.945)^{-2.64} - (2.999)^{-5.28} - (1.933)^{-7.92} \right]$$

$$\equiv [0.1684]\ (1.0747) = \underline{\underline{0.181}}$$

Plume length (along centerline)

$$\zeta_\theta = n\sqrt{b_o h_o}\;(\theta/\theta_0)^{-\beta}$$

Plume Width

$$b_\theta = b_o + m\,\zeta_\theta$$

$\therefore\ \zeta_{3^\circ} = (5.94)(4.47)(3/12)^{-1.1483} \equiv \underline{130.4}$ $\quad b_{3^\circ} = 5' + (0.181)130 = 28.5'$

$\zeta_{10^\circ} = (26.5451)(10/12)^{-1/1483} \equiv \underline{32.7'}$ $\quad b_{10^\circ} = 5' + (0.181)(32.7) = 10.9'$

$\zeta_{8^\circ} = \underline{42.3'}$ $\quad b_{8^\circ} = 5' + (0.181)(42.3) = 12.6'$

$\zeta_{4^\circ} = \underline{93.7'}$ $\quad b_{4^\circ} = 5' + (0.181)(93.7) = 21.9'$

$\zeta_{2^\circ} = \underline{207.8'}$ $\quad b_{2^\circ} = 5' + (0.181)(207.8) = 42.6'$

$\zeta_{1^\circ} = \underline{460.6'}$ $\quad b_{1^\circ} = 5' + (0.181)(460.6) = 88.4'$

$\zeta_{0.5^\circ} = \underline{1020'}$ $\quad b_{0.5^\circ} = 5' + (0.181)(1020) = 190'$

Time of exposure: $t_\theta \equiv \sum_{i=1}^{n} (\Delta\zeta_i/\bar{q}_i)$ Where $\bar{q}_i = {}^1/_2(1/q_i + 1/q_{i-1})^{-1}$

q_θ	$\bar{q}_\theta$	τ_θ
q_{12}		
	10.9	2.2 Sec + 0.6 = 2.8 Sec.
q_{10}		
	8.9	2.8 + 1.1 = 3.9 Sec.
q_8		
	5.3	3.9 + 15.1 = 19.0 Sec.
q_4		
	3.4	19.0 + 10.8 = 29.8 Sec.
q_3		
	2.4	29.8 + 32.2 = 1 min 2 Sec.
q_2		
	1.3	1 min 2 Sec. + 3 min 14 Sec. = 4 min 16 Sec.
q_1		
	0.7	4 min 16 Sec. + 13 min 18 Sec. = 17 min 34 Sec.
$q_{0.5}$		

Exhibit 39

Thermal Plume Calculations (con't)

TABLE 1

Ambient Water Temperature = 65°F

θ(°F)	ζ_θ(ft)	b_θ(ft)	τ_θ	A(acres)
12	26	10	2 Sec.	<0.01
10	33	11	3 Sec.	<0.01
8	42	13	4 Sec.	0.01
4	94	22	19 Sec.	0.05
3	130	28	30 Sec.	0.09
2	208	43	1 Min 2 Sec.	0.23
1	461	88	4 Min 16 Sec.	1.03
0.5	1020	190	17 Min 34 Sec.	4.93

Case #2 - Ambient lake water temperature = 35°F is done in the same way.

F_o = 132.07

n = 6.47

β = 1.03

m = 0.163

TABLE 2

Ambient Water Temperature = 35°F

θ(°F)	ζ_θ(ft)	b_θ(ft)	τ_θ	A(acres)
12	29	10	2 Sec.	<0.01
10	35	11	3 Sec.	<0.01
8	44	12	4 Sec.	0.01
4	90	20	12 Sec.	0.05
3	121	25	21 Sec.	0.08
2	183	35	47 Sec.	0.16
1	374	66	3 Min 14 Sec.	0.63
0.5	764	130	12 Min 56 Sec.	2.52

Source: Reserve Mining Company, and Dr. Donald W. Pritchard of the Johns Hopkins University.

Exhibit 39

One of the parameters which enter the thermal plume model is the densimetric Froude number (F), which contains the density difference ration $\Delta \rho/\rho$, and therefore varies with ambient temperature. For this reason, computations of the dimensions of Reserve's thermal plume have been made at two ambient temperatures, 65°F and 35°F.

Plume Description: This submerged discharge will create a plume of heated water which will entrain and mix with ambient Lake Superior water. The excess temperature will be dissipated rapidly. As shown above, it is expected that the total area enclosed by the 0.5° excess temperature isotherm will be less than 5 acres.

The configuration and location of the nozzle and the resulting thermal plume is important to ensure that the least amount of lake area is involved. This minimizes the thermal effect of the excess temperature on living organisms in or on the bottom of the lake.

The plume width varies from 25 feet at a 3°F excess temperature, to about 130 feet at a 0.5°F excess temperature, with exposure times of about 21 seconds and 3 minutes, respectively.

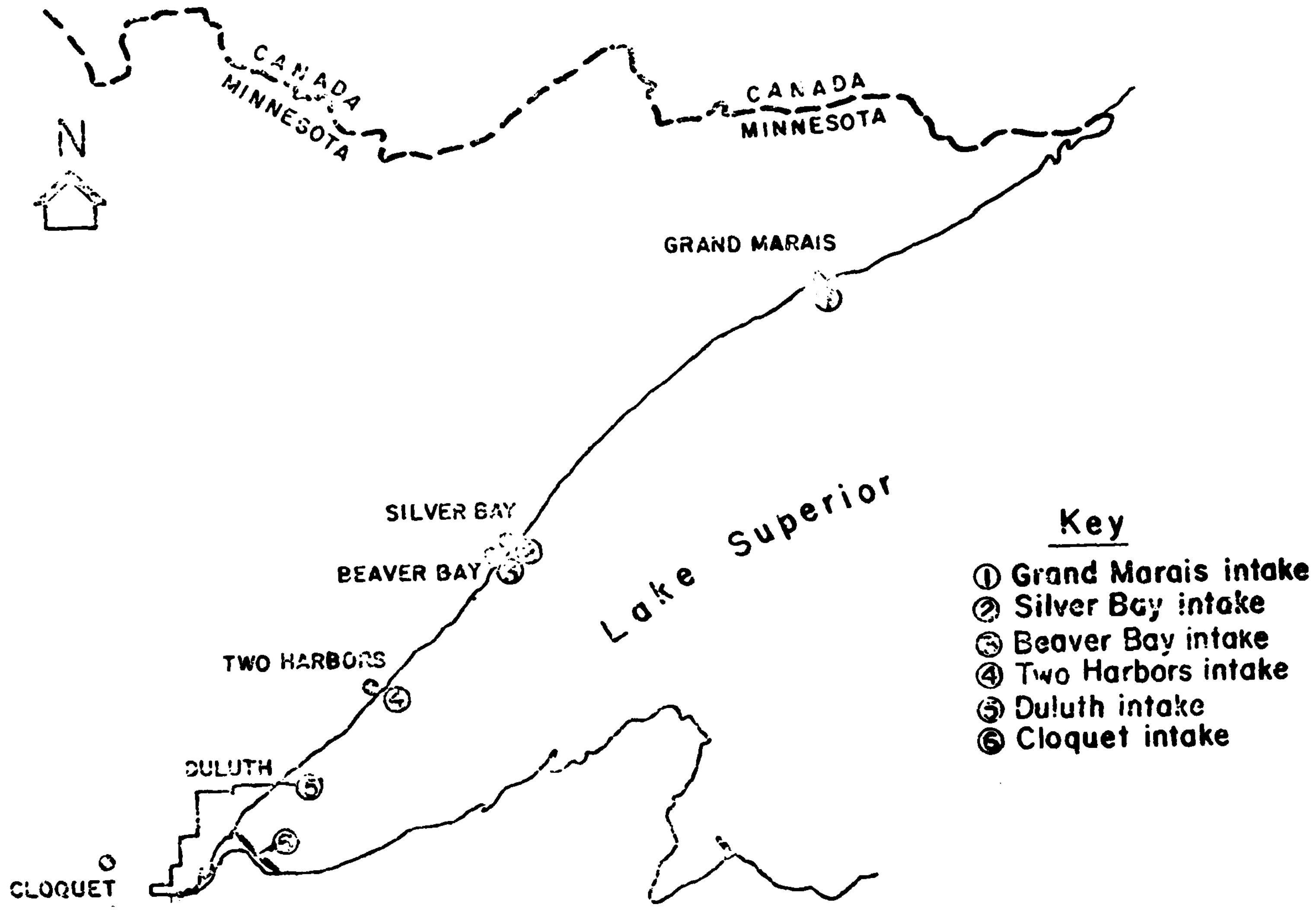
Based on Reserve's discharge flow (236 cfs) and excess temperature (12°F), according to EPA guidelines about 200 acres would be allowed for a surface discharge of that magnitude to meet a standard of 0.5° maximum excess temperature. It is expected that the actual zone in the 0.5° excess temperature will cover less than 5 acres.

Reserve's current meter studies have shown that the predominant lake currents in the Silver Bay area move generally parallel to the north shore towards Duluth. The current velocity is very small, ranging from a typical value of 0.03 fps to 0.3 fps. The effluent jet velocity will be about 12 fps. Therefore, only a minor amount of bending can be expected on the outer edge of the plume.

AVERAGE CHEMICAL CHARACTERISTICS OF LAKE SUPERIOR

Parameter	Amount
Total Phosphorus	
Open Lake	5 ppb
South Shore	10-15 ppb
Average	13.6 ppb
Calcium	12.4 ppm
Magnesium	2.8 ppm
Potassium	0.6 ppm
Sodium	1.1 ppm
pH	7.4
Specific Conductance	78.7 K18 x 10^6 O 18°C
Total Dissolved Solids	59 ppm
Total alkalinity ($CaCO_3$)	46 ppm
Bicarbonate	59 ppm
Carbon Dioxide	
Surface	0.6-2.2 ppm
Depth	0.7-8.5 ppm
Sulfate	1.2 ppm
Silica	5.0 ppm
Nitrogen	0.15 ppm
Chloride	1.9 ppm
Turbidity	Trace
Free Ammonia	0.1 ppm
Iron	0.062 ppm

WATER SUPPLY INTAKES FROM LAKE SUPERIOR



Vegetation Analysis Drawn From Reserve Mining Company's
Environmental Report Prepared by A.D. Little, Inc.

<u>Aspen and Aspen-White Birch Type</u> (51% of the area)

The aspen types include relatively pure stands of trembling aspen in addition to stands of aspen in combination with white birch, with white birch and balm-of-Gilead, and with black ash and balm-of-Gilead. The stands range in age from 50-70 years and are mature to over-mature. Some groups of aspen are disintegrating badly while the birch tends to be in generally better condition. Site quality for aspen and birch in these areas ranges from medium to good.

The understory includes small areas of balsam fir and occasionally poor aspen reproduction, and more generally an abundant shrub cover. The most commonly occurring shrub species were American hazel (ranging from 5-75% of ground cover and averaging 30% at heights of 4-10 feet), speckled alder (ranging from 0-100% cover, averaging 20% at heights of 5-20 feet), and mountain maple (ranging from 0-75% cover, averaging 20%, at heights of 3-7 feet). Other shrub layer species occurring with less frequency and coverage were bush honeysuckle, red osier dogwood, thimbleberry, raspberry, wild cherries, low juneberry, red maple, sugar maple, trembling aspen, red elderberry, and balsam fir.

Sample plots showed that the ground was 50-100% litter covered in this type. The dominant herbs were large-leaved aster whose percent cover ranged from 0-75% but was most frequently in the 0-25% class, bristly dewberry, sedges, grasses, and ferns. Other herbs contributing significantly to that layer were clintonia, bunchberry, and mosses. Remaining herbs of lesser consequence were clubmosses, blueberry, strawberry, wild current, meadow rue, violets, horsetail, and sarsaparilla. These herbs were most commonly in the 0-25% cover class.

White Birch Type (74% of the area)

White birch type is generally nearly pure white birch, sometimes having a minor component of aspen or red maple. The stand condition of the birch is good, but the high density of these stands tends to keep the stems in a smaller diameter class and may tend toward growth stagnation. Stand ages are estimated at 50-70 years. The sites on Mile Post #7 tend to be medium to good although the pure birch stands tend to be on drier sites than the birch with aspen.

There is generally no tree understory because of the dense canopy. The next layer is shrubs which are dominated by mountain maple (ranging in coverage from 0-75%, averaging 25%, at heights of from 2-8 feet), thimbleberry (ranging in cover from 5-100%, averaging 15%, at heights of 2-4 feet), and American hazel (ranging from 5-50% cover, averaging 15%, at heights of 3-8 feet). Red maple and sugar maple were found occurring on west-facing steep slopes in concentrations of 50% cover and heights of 6 inches to 7 feet. Other shrubs were bush honeysuckle, raspberry, and wild cherries.

The herb composition in this type is very similar to that of the aspen-birch type. The ground is more than 90% litter covered, but the litter is quite thin. Large-leaf northern aster dominates the herb layer covering 25-50%. Bristly dewberry, strawberry, sedges, fern, and violets were other herbs recorded. These remaining herbs were in the 0-25% cover class.

Upland Hardwood Type (9% of the area)

This type consists of various combinations of sugar maple, red maple, basswood, white and yellow birch, white spruce, balsam fir, white cedar, and occasionally red oak, black ash, and aspen. The condition of these stands is generally good. The maple will maintain a cover indefinitely while the spruce and birch are generally mature. The age of trees in this type is mixed and ranges from 40-100 years.

The understory may be dense sugar and red maple reproduction up to 100% cover while in areas of less dense overstory, mountain maple, thimbleberry, and hazel may cover up to 50% of the area. The litter layer is thin but extensive with large-leaved northern aster and violet in the herb layer.

Lowland Hardwood Type (4% of the area)

This type is composed of pure stands of black ash, pure stands of balm-of-Gilead, and mixtures of these two species with white birch. In some places this type has a component of balsam and cedar. The forests in the lowland type range in age from 50 to 70 years with some black ash of all ages up to 100 years. The condition of the trees is generally good except that the balsam is often overmature and falling. This type occurs in moist lowland areas in an organic soil or wet mineral soil with a layer of muck on the surface. Sites range from good to poor depending on the degree of flooding.

The understory generally has some ash reproduction and some balsam reproduction. The dominant shrubs are hazel and green and speckled alder. The hazel is in the 0-50% cover class while the alders are higher, in the 50-75% cover class. Other shrubs are wild cherry, red-berried elder, and maple. All of these fall into the 0-25% cover class.

The ground is 50-100% litter covered. The dominant herbs are grasses, raspberries, fern, and large-leaved aster. Others of lesser importance are raspberries, sedge, violet, and horsetails. Each of these are in the 0-25% cover class.

Upland Spruce-Fir Type

This type generally has a mix of species composed of white spruce, balsam fir, white birch, white cedar, trembling aspen, red maple, and black ash. The age is variable up to 100 years. The white spruce and

the larger birch are generally mature while the balsam fir is generally over-mature and falling. The stands are generally not well stocked. Good sites for this type are those which are moist while the high dry areas provide rather poor sites.

The understory has varying degrees of balsam fir and spruce regeneration from 1 to 20 feet high. The shrub layer has a variable cover of speckled alder, hazel, and mountain maple. On the drier sites lichens compose the herb layer.

Spruce-Tamarack Type

Black spruce dominates this type with tamarack as a minor component. The organic soils supporting these species provide a medium to good site but may grade to poor in wetter spots. The stand condition is good at an age of 50-70 years.

The shrub layer in this type is very sparse. Labrador tea is the most abundant shrub and averages less than 5% cover. It is a low shrub, ranging from 6 inches to 18 inches in height. The herb layer is a thick mat of moss, lichens, and clubmosses with sphagnum moss predominating. Sedges may cover up to 5% and blueberries only 1 to 2%.

Cedar Type

White cedar in pure stands makes up only a small portion of this type. Most of the type is a mixture of white cedar and black spruce or mixtures of white cedar, balsam fir, tamarack, and black spruce. The density of the tree cover ranges from scattered trees to about 75% cover. The generally low densities make the stand condition good for survival but poor for product quality. Trees may range in age from 5-100 years. The sites are generally wet organic soil with a poor site quality.

The understory vegetation generally bars reproduction of all the tree species present. The shrub layer is dominated by alders (ranging in ground cover from 5-75%, averaging 40%, with a height of 5-20 feet) and Labrador tea (cover ranges 5-75%, averaging 25%, height is 1-2 feet). Red osier dogwood averages about 5% cover at heights of 2-4 feet. The ground cover is similar to the spruce-tamarack type with a thick moss-lichen-clubmoss layer covering up to 100%. Sedges are important components in some areas along with bunchberry and grasses (cover ranges 0-25%). Clintonia, bristly dewberry, and goldthread were other important members of the herb layer. Of lesser importance were horsetail, blueberry, cranberry, sarsaparilla, strawberry, bedstraw, and ferns.

Pine Type

The pine type is represented by one small area of pure white and red pines which mix with balsam fir and white birch on the edges of the type. The 50-70 year old stand is in good condition on a hillside site that ranges from medium to poor quality.

Upland Brush Type

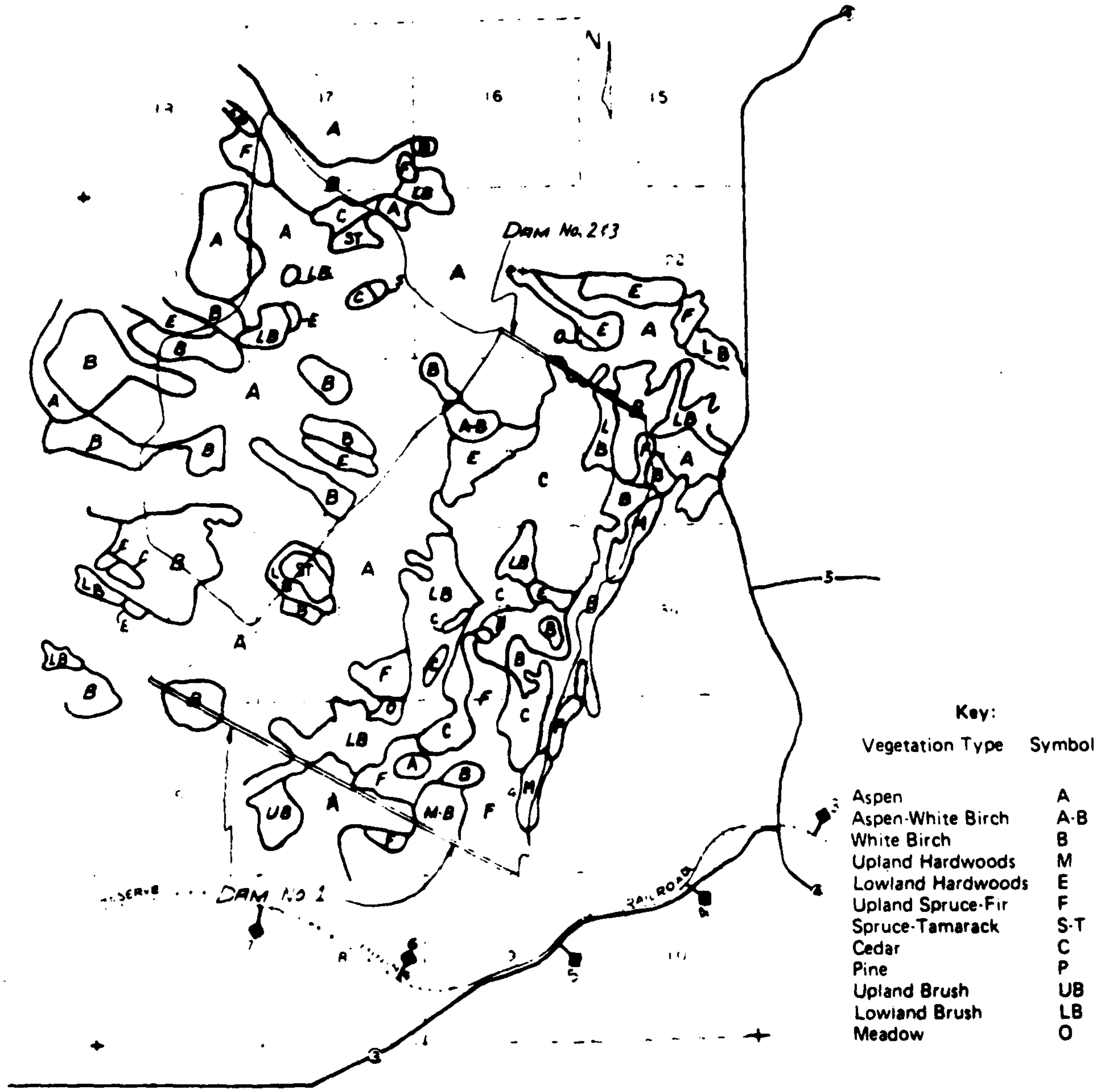
Upland brush type is dominated by shrub species although there may be scattered white birch, trembling aspen, and balsam fir trees included. Hazel, alder, mountain maple, and cherry are the major shrub species that cover up to 100% of this type.

Lowland Brush Type

This type is characterized by dense thickets of one or more shrub species. Speckled alder (5-15 feet), willows(5-10 feet), bog birch (2-4 feet), and Labrador tea (1-2 feet) are the dominant species occurring in pure and mixed stands. Red osier dogwood frequently occurs as a secondary shrub understory (5-10% cover) and in isolated small clumps (2-4 feet in height). The herb layer composition is similar to that in the spruce-tamarack and cedar types. In addition, bullrush, strawberry, aster and goldenrod were occasionally found.

Meadow Type

The meadow type surrounds an abandoned farm and is composed of sedges, grasses, and goldenrod interspersed with clumps of spirea, alder, and wild cherry.



Source: Reserve Mining Company

VEGETATION TYPES – MILEPOST =7 SITE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

IN REPLY REFER TO:
AFA-SE

Mr. Robert F. Post
Chief, Environmental Resources Branch
Engineering Division
St. Paul District
Corps of Engineers
Department of the Army
1135 U. S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Mr. Post:

The following is in response to your request of October 26, 1976, on the potential impacts of the taconite tailings disposal at five proposed sites in Lake County, Minnesota, on threatened or endangered flora or fauna.

The Arctic peregrine falcon and Eastern timber wolf are presently listed as endangered species by the Fish and Wildlife Service and are found within the general area you described. It is possible the Arctic peregrine falcon passes through these areas during the spring and fall migrations.

We feel tailings disposal activities will preclude timber wolf utilization of a dump site as long as the dumping is active. Abandonment of a dump site with subsequent revegetation might eventually result in renewed use by prey species of wolves and thus a return of the site to wolf habitat.

All of the five proposed sites are in primary wolf range. Effects of the tailings disposal on the various sites would not be uniform. The Embarrass site is well outside the Superior National Forest exterior boundaries and is in the heart of the Mesabi Iron Range. Its wolf habitat potential for the near future has been lost. Colvin, Snowshoe and Midway sites are within the exterior boundaries of the Superior National Forest. We feel certain these sites are presently used by wolves.

Milepost 7 is mostly outside of the exterior boundaries of the Superior National Forest, and is in relatively unspoiled habitat. Wolf complaints had been answered at Beaver Bay, two miles south of Milepost 7.

At present there is no Critical Habitat established for these species. However, the potential for establishment of Critical Habitat should be kept in mind in your planning efforts.

The Federal Register for June 16, 1976, proposes a number of plant species for the endangered species list, some of which may be found within the area of concern. Consideration for these species and the probability of listing them as endangered should be included in all planning efforts.

We hope this information is of assistance to you in the development of environmental impact documents and look forward to the opportunity to review the same.

Sincerely yours,

MINNESOTA HISTORICAL SOCIETY
Fort Snelling Branch (Building 25), Fort Snelling, St. Paul, Minnesota 55111 • 612-726-1171

2 June 1975

William L. Goetz, Chief
Construction-Operations Division
Saint Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
Saint Paul, Minnesota 55101

Dear Mr. Goetz:

RE: Application for Permit: Reserve Mining Company
For the Placement of a Diffuser Pipe and
For the Placement of Rock Beneath This Pipe
To Construct a Power Plant Condenser Cooling Water Discharge Diffuser System
On Beaver Island
Section 5, T55N, R7W
Silver Bay, Minnesota

The application for permit listed above has been reviewed by the Survey and Planning and Archaeology sections of the Minnesota Historical Society as per your request of 14 May 1975. It is the finding of this review that historic records indicate that there were structures on Beaver Island during the pioneer era. It is, therefore, requested that a survey be made of the project area prior to implementation of construction.

If you should have any questions or comments on this matter, please contact Mr. Alan R. Woolworth, Chief Archaeologist, Minnesota Historical Society.

Respectfully,

Russell W. Fridley

Russell W. Fridley
State Historic Preservation Officer

RWF/cr

cc: Alan R. Woolworth; Chief Archaeologist; Minnesota Historical Society; Building 27, Fort Snelling; St. Paul, Minnesota 55111

Charles W. Nelson, Supervisor - E.I.S.: Historic Sites Survey and Planning; Building 25, Fort Snelling; St. Paul, Minnesota 55111

Exhibit 44

23

MINNESOTA HISTORICAL SOCIETY

690 Cedar Street, St. Paul, Minnesota 55101 • 612-296-2747

May 5, 1976

Colonel Forrest T. Gay
District Engineer
St. Paul District
Corps of Engineers
1135 U. S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Gay:

IN RE: NCSCO-S (76-20-237-000-02)
Reserve Mining Company, Silver Bay
Permit to develop an on-land tailings disposal area
Mile Post 7 in Lake County

The project described above has been reviewed pursuant to responsibilities given the State Historic Preservation Officer by the National Historic Preservation Act of 1966 and the Procedures of the National Advisory Council on Historic Preservation (36CFR800).

Considerable attention has been given this application by both the Survey and Planning and the Archaeology sections of the Minnesota Historical Society.

To the best of the Society's knowledge, there are no historic structures within the area affected. There are, however, several known historic sites as well as suspected prehistoric sites which should be investigated prior to construction.

The known historic sites are the Henry Wieland homestead on the NE 1/4 of section 17, the Greenwood Trail running through sections 31, 6, 8, and 9, and a logging camp site in section 7. The Society's archaeology section also believes that the proposal area possesses considerable archaeological potential.

Therefore, the Minnesota Historical Society requests that prior to construction an archaeological survey be prepared to cover both historic and prehistoric sites. Questions about such a survey, should they arise, may be directed to me.

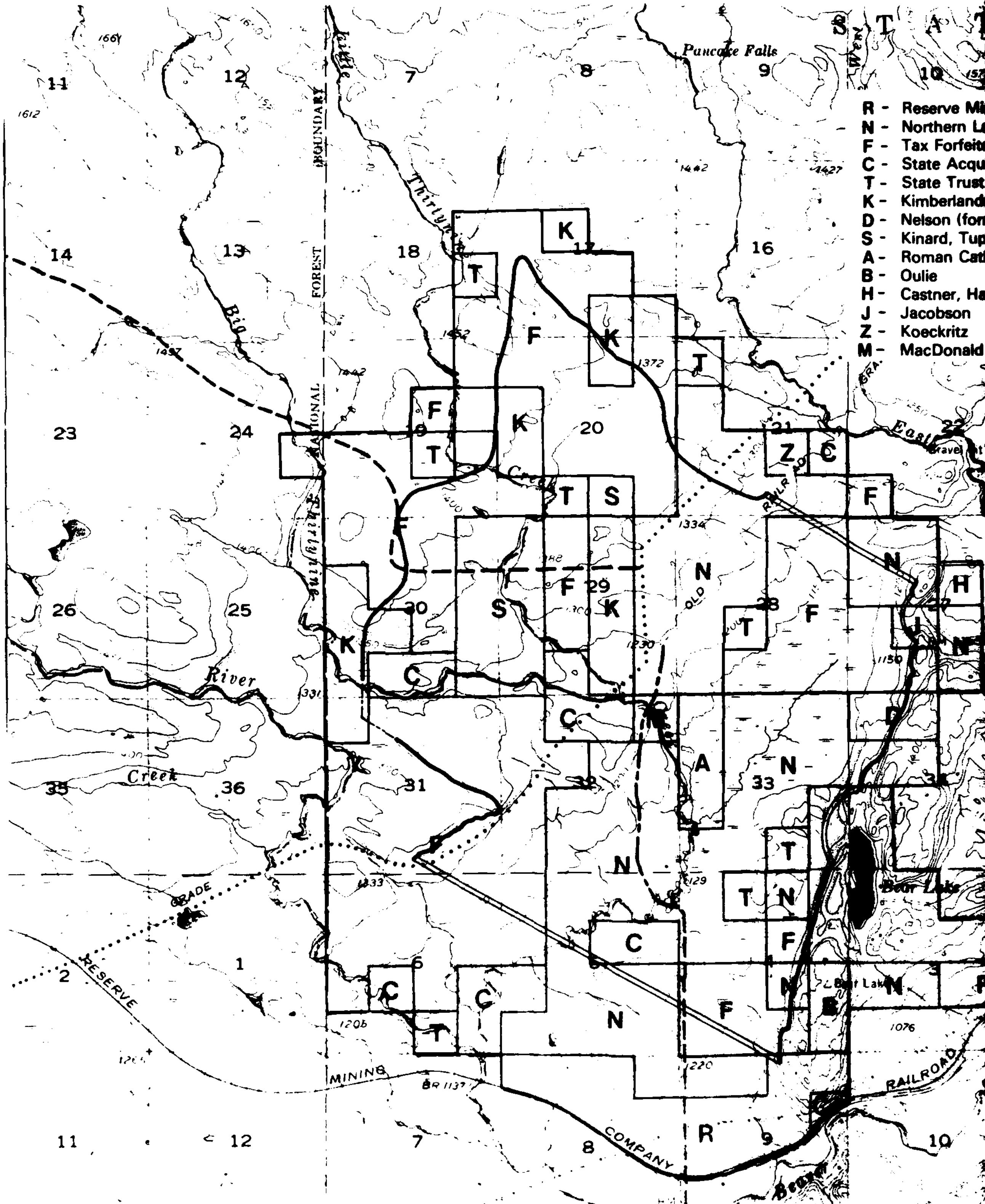
Your continued attention to historic and archaeological values in the review and construction process will be appreciated.

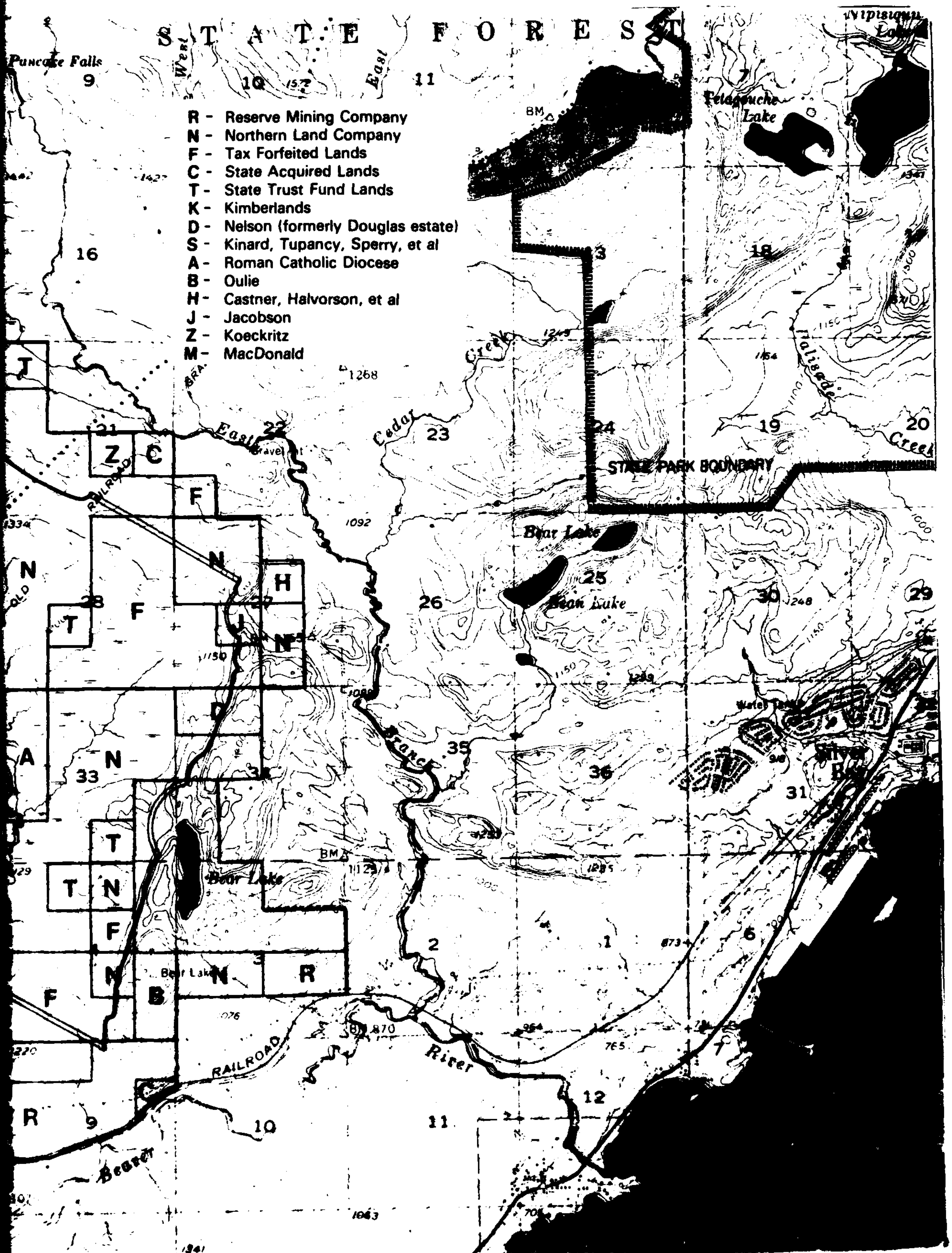
Sincerely,

Russell W. Fridley
State Historic Preservation Officer

RWF:ALF

Exhibit 44


STAT
R - Reserve Mi
N - Northern L
F - Tax Forfeit
C - State Acqu
T - State Trust
K - Kimberland
D - Nelson (for
S - Kinard, Tup
A - Roman Cat
B - Oulie
H - Castner, Ha
J - Jacobson
Z - Koeckritz
M - MacDonald
Pancake Falls
NATIONAL FOREST BOUNDARY
Big River
Creek
Bear Lake
RESERVE MINING COMPANY RAILROAD
GRADE
OLD RAILROAD



Land ownership map Exhibit 45

1 2

Surface Water Monitoring

Reserve sampled the Beaver River below Highway 61 (Mile post 7 Monitoring Station 7) 25 times between January 1971 and June 1972. This data, together with that generated in the nine months since the present Mile Post 7 water quality monitoring program began, gives over two years of valuable historical background water quality data on the Beaver River.

The East Branch Beaver River drains the area north of the Mile Post 7 basin. The main branch of the Beaver River receives the water diverted from the area west of the basin and the drainage from south of the basin. Some of the area east of the tailings basin drains into Bear Lake, then into the Beaver River.

Seven sampling stations have been selected in the Beaver River basin, some upstream from the proposed tailings basin and others downstream. One sampling station has been selected on Bear Lake. The following page shows the location of these sampling stations in relation to the tailings disposal area. The stations are the same sites used for stream biota monitoring in the "Stream Biota Monitoring" (exhibit 32).

Sampling stations #1 and #2 are on the East Branch Beaver River (Figure 1). Sampling station #1 is upstream from the tailings basin out of any potential influence of tailings pond construction or operation. Sampling Station #2 is downstream from the tailings basin. Abnormal differences in analytical results between samples taken at stations #1 and #2 may be due to the effects of constructing or operating Mile Post 7 tailings basin.

Sample station #3 will evaluate Thirtynine Creek before this water is diverted to by-pass the tailings basin. It will be sampled during preoperational monitoring only. This station will be covered early in the tailings basin operation.

Sampling station #4 will give upstream measurements of the Beaver River and when compared to the results of preoperational monitoring of sampling stations #3 and #4, the operation measurements should show any effect of the stream diversions.

Sampling stations #5 and #6 should show the effects, if any, of the tailings basin construction and operation on the waters of the main branch of the Beaver River.

Sampling station #7 was selected to monitor the total flowage of the Beaver River.

Sampling station #8 will monitor the water of Bear Lake.

Station #9 is on the Split Rock River above the Highway 61 crossing. Station #10 is on the Baptism River above the Highway 61 crossing. The Split Rock River is the first stream southwest and the Baptism River is the first stream northeast of the Beaver River. The three streams are

Surface Water Monitoring (con't)

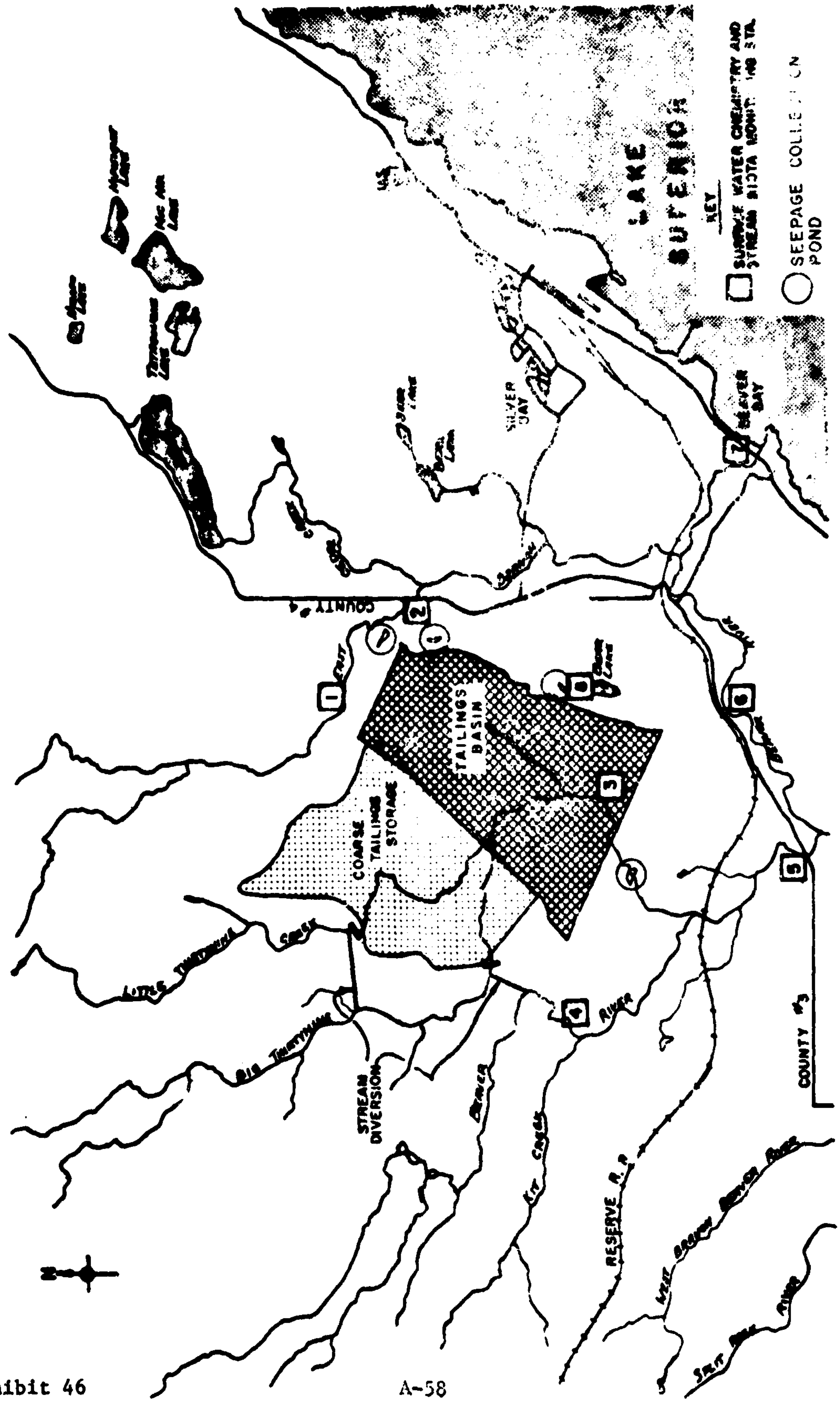


Exhibit 46

close enough that they should have similar fluctuations in water analyses. Station #9 and #10 are control stations to give relative normal fluctuations.

The table below lists the 43 chemical and bacteriological parameters to be measured on water samples taken from these sampling stations. In addition to the chemical and bacteriological measurements, the suspended sediments from all water samples will be qualitatively analyzed by x-ray diffraction to determine the minerals present.

The preoperation study was started in September, 1974 and will continue until construction is complete and tailings are being pumped into the tailings basin. Nine stations are presently being sampled on a monthly basis, and as the Bear Lake station becomes available it will also be added to the sampling program. The present monitoring program will be continued until the on-land deposition of tailings has begun. After the start of on-land deposition continued water analyses will enable the detection of possible water quality effects on the Beaver River from the operation.

Forty-three (43) separate parameters have been measured (some on all samples, some periodically) during these sampling periods. These same 43 parameters will continue to be monitored monthly until the implementation of the proposed Mile Post 7 tailings disposal system giving a minimum of approximately 5-6 years of background water quality data on the Beaver River. It should also be noted that a minimum of approximately 3-4 years background water quality data will be generated from the present monitoring program on streams tributary to the Beaver River and draining the Mile Post 7 disposal area.

The frequency of sampling and parameters analyzed for the first three to five years of the tailings basin operational monitoring program will be essentially unchanged from the preoperational monitoring. The dam seepage collection catch basins will become sampling stations. The approximate locations of these catch basins are shown in the figure above. to five years after the tailings basin is in operation, the monitoring program will be reviewed and adjusted to fit the requirements indicated by the data collected to that time.

In addition to the water quality monitoring program now in progress, Reserve has periodically sampled the Beaver River below Highway 61 (Mile Post 7 Monitoring Station 7) since January 1971. During the time January 1971 to June 1972, the Beaver River was sampled on 25 separate occasions. These results show considerable fluctuation during this 18-month period. See Table 3. For example, alkalinity varied from a high of 50.47 mg/l to a low of 7.42 mg/l, calcium from 16.4 mg/l to 3.9 mg/l, and pH from 8.57 to 7.10. This data, together with that generated in the present Mile Post 7 water quality monitoring program, gives over two years of valuable background water quality data on the Beaver River.

Surface Water Monitoring (con't)

TABLE

Water Parameters to Be Monitored in Surface and Ground Waters†

Calcium	Ammonia-N *
Magnesium	Nitrite-N *
Sodium	Nitrate-N
Potassium	Cyanide *
Alkalinity	Phenol *
Sulfate	Arsenic*
Chloride	Selenium *
Fluoride	Total Solids*
Silica	Dissolved Solids**
Soluble Ortho Phosphorus**	Suspended Solids*
Total Phosphorus*	Turbidity* JTU
Iron	Color**
Manganese	Specific Conductance*
Copper	pH*
Zinc	Temperature*
Nickel	Dissolved Oxygen*
Cadmium	Chemical Oxygen Demand*
Lead	5-Day Biochemical Oxygen Demand*
Cobalt	Fecal Coliform Bacteria*
Chromium	Total Coliform Bacteria*
Mercury *	Fecal Streptococci Bacteria
Silver*	

*Analysis determined on unfiltered sample only.

**Analysis determined on filtered sample only.

† All parameters will be measured on filtered and unfiltered samples unless otherwise specified.

NOTE: Periodic measurements will be made for the following parameters: barium, boron, amine, total salinity, hydrogen sulfide, methylene blue active substances, flocculant, carbon chloroform extract and radio-active materials.

Ground Water Monitoring

A ground water monitoring program will evaluate the effect, if any, of depositing tailings in the Mile Post 7 tailings disposal site on the ground water of the area.

E. A. Hickok & Associates have established the location of the ground water sampling wells. Well locations were selected by analysis of data obtained in field studies of the Mile Post 7 tailings disposal area. (See figure on next page.)

One six and 1/4-inch diameter bore hole will be drilled down to and five feet into rock at each location. A four-inch diameter plastic casing with a 10 foot screen will be extended to the bottom of the bore hole. The bottom 12 feet will be gravel packed. The bore hole will then be grouted to the surface. The casing will be capped at the surface.

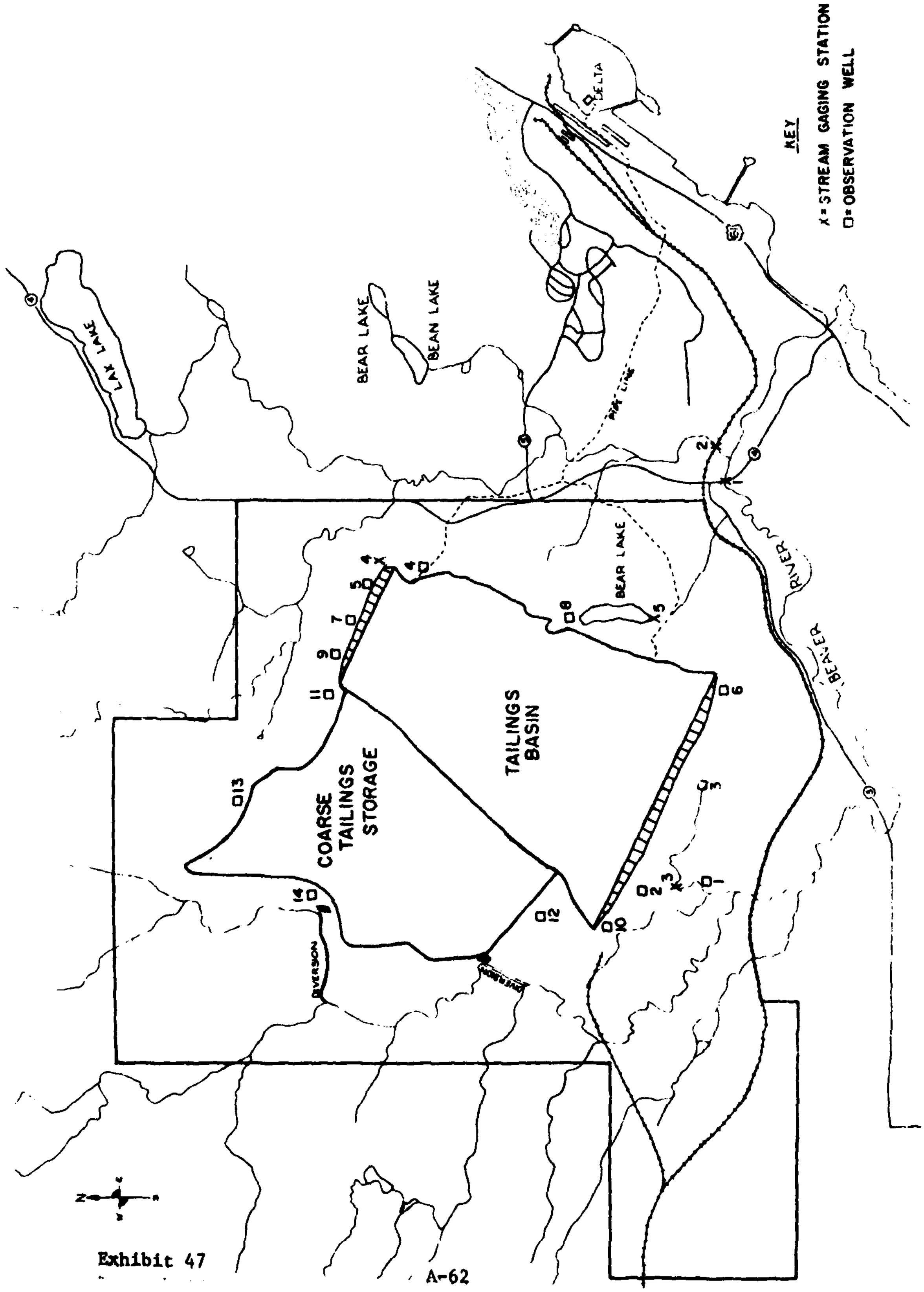
One eight and 3/4-inch diameter bore hole will be drilled to the center of the till zone at each location. A four inch plastic casing with a 10 foot screen will be extended to the bottom of the bore hole. Seven feet of gravel packing will be installed and the bore hole will be grouted up to the interface of the till and lake sediments. A two inch diameter plastic casing with a five foot screen will bottom at the lake sediment-till interface. Seven feet of gravel packing will be installed and the bore hole will be grouted to the surface. Both well casings will be capped.

This program will enable samples to be taken at the rock-till interface, the midpoint of the till zone and the till-lake sediment interface.

The preoperational monitoring will be started promptly after the test wells are drilled and continued until the deposition of tailings begins. Samples will be taken monthly. The chemical and bacteriological parameters listed in Exhibit 31 will be measured on the water samples. The suspended sediments will be analyzed by x-ray diffraction to determine the minerals present.

The frequency of sampling and parameters analyzed for the first three to five years of the tailings basin operational monitoring program will be unchanged from the preoperational monitoring. In the period of three to five years after the tailings basin is in operation, the monitoring program will be reviewed and adjusted to fit the requirements indicated by the data collected to that time.

Ground Water Monitoring (con't)



Approximate Location of Ground Water Wells

Exhibit 47

Stream Biota Monitoring

A plan for monitoring stream biota has been developed to determine the effect, if any, of tailings deposited in the Mile Post 7 disposal site on the aquatic life of the streams draining the area. The same sample stations planned for surface water monitoring, exhibit 46, are also being used for the biota monitoring. These sampling stations are described in detail in exhibit 46.

All methods used for the biota monitoring and analysis are those suggested in "Biological Field and Laboratory Methods for Monitoring the Quality of Surface Waters and Effluent," by the Environmental Protection Agency, and in "Standard Methods," 13th Edition, American Public Health Association, et al., 1971.

Samples are being collected during the first part of each month from about May 1 to December 1 of each year. Biota being studied include the macroinvertebrates, periphyton, macrophyton and plankton. Monitoring of these major groups in the river systems near Mile Post 7 will provide pertinent information for assessing the water quality before, during and after the on-land deposition of tailings. All these groups are sensitive to changes in their environment and will serve as indicators of changing conditions.

Sampling for biota is being coordinated with the surface water monitoring program.

<u>Macroinvertebrates</u>:

Macroinvertebrates are being collected with the use of a Surber stream bottom sampler. An Eckman dredge will be used in waters too deep or where the bottom is too soft to sample with the Surber stream sampler. However, standardization of a particular sampler type within a given station and a given drainage basin for comparative purposes is important and will be adhered to wherever possible. A Ponar dredge will be used on Bear Lake.

Samples at each station are being collected from a variety of substrate types, stream velocities and depths to obtain representative organisms of each area. Samples are preserved in the field with 10% formalin and brought back to the laboratory for identification and counting. Specimens are preserved in 70% ethanol for future reference.

<u>Periphyton (Attached Algae)</u>:

Periphyton from the rivers are being collected and periphyton from Bear Lake will be collected from a variety of substrates for microscopic identification. Regrowth plates made from standard microscope glass slides placed at each station for varying periods, reflect both the qualitative and quantitative algae biomass.

Laboratory analyses will include total dry weights, total organic dry weights, chlorophylls a, b and c, and microscopic examination for types of periphyton present and densities (counts).

Plankton (Free Floating Algae and Fauna):

Plankton are being collected at each sampling site for microscopic examination to determine the types present and their densities. Total dry weight, total organic dry weight and chlorophylls a, b and c determinations are used to measure and define the planktonic biomass.

Miscellaneous:

Macrophyton (plants other than algae) including floating, submersed and emersed plants,are identified and recorded. Observations of the general characteristics of the waters such as foam from humates, coloration of water, etc., are recorded.

Taxonomic keys are being used in the identification for the following: Macroinvertebrates (Usinger - 1974, Pennak - 1953, Cook - 1956, Nicholson - 1950 and Harden - 1952); Prescott - 1973, Whitford - 1973 and Smith - 1950); Chlorophyll extraction procedures after Richards - 1952 and concentrations are calculated with trichometric equation of Parsons - 1963; Plankton Fauna (Pennak - 1953); and Macrophyton (Hotchkiss - 1967 and Muenscher - 1967).

East Branch Beaver River:

Station #1 is located on the East Branch about 1/5 mile upstream from its intersection with the abandoned Alger-Smith railroad grade. This portion of the river is upstream and away from any influence of tailings deposition. Preoperational sampling of the biota will indicate if natural differences do exist from stations downstream. This site will serve as a control station for the East Branch during construction and operational periods to assess any changes in the downstream biota. The sediment consists mainly of boulders, rubble, coarse to medium gravel and some sand. The relief of the stream is pronounced, creating many rapids and riffle areas and some small falls and pools.

Station #2 is located on the East Branch Beaver River about 1/10 mile west of County Road 4 outside the tailings disposal area. An intermittent creek which drains the area downstream from the north dam enters the East Branch about 1/10 mile above station #2. A seepage collection basin will be located on this creek. The location of this sampling station will be downstream from direct influence of the northeast area of the proposed tailings disposal site. Preoperational sampling of the biota provides baseline information to assess any effect from the construction or operation of the on-land tailings deposit. Sediment type consists of rubble, coarse to medium gravel and sand. The relief of the stream is gradual, creating some riffle areas and a number of large pools.

Stream Biota Monitoring (con't)

Thirtynine Creek:

Station #3 is located on Thirtynine Creek near an abandoned farm. Although this area will be inundated by the deposition of tailings, preoperational biota sampling here will provide pertinent information needed to assess some of the effects of diverting the Thirtynine Creeks and covering portions of these streams with tailings.

Diversion Areas:

Station #4 is located on the main branch of the Beaver River about 1/4 mile upstream from the Kit Creek tributary. This area is downstream from the diversions of Little and Big Thirtynine Creeks, outside the tailings disposal area. Preoperational monitoring of the biota of this area will provide baseline information in assessing any effect the diversions might have. Also, information obtained will aid in evaluating reestablishment of the biota in this area after construction of the diversions. This station is above the proposed tailings basin. The results of this sampling will be used to assess the construction and operation of Mile Post 7 on the downstream areas of the Beaver River. The relief of the stream is gradual with few riffle areas. The area has many beaver dams and ponds. The sediment type in this area is mostly organic.

Beaver River:

Station #5 is located about 1/5 mile north of where County Road 3 crosses the Beaver River. The location of this sampling station will be downstream from the disposal site. Preoperational monitoring of the biota will provide baseline information in assessing any effect of on-land tailings deposition. Sediment consists of coarse to medium gravel, rubble and sand. The relief is gradual, creating a variety of large pools with some riffle areas.

Station #6 is located about 150 yards upstream from the Glen-Avon Falls on the Beaver River. This area is out of the taings disposal area, about 1/10 mile downstream from an intermittent tributary coming from the southeast area of the proposed tailings site. Preoperational sampling of the biota will provide baseline information in assessing any effect from on-land tailings disposal. Sediment consists of rubble with some gravel and sand. The relief is moderate, creating many rapids and riffle areas with occasional pools.

Stream Biota Monitoring (con't)

Total Beaver River:

Station #7 is located about 1/5 mile upstream from the city of Beaver Bay, outside the tailings basin area. This station represents the total drainage of the Beaver River, without the influence of Beaver Bay. Preoperational monitoring of the biota will provide baseline information to assess the total effect on the Beaver River from on-land tailings disposal. Sediment type consists of rubble, coarse to medium gravel and some riffle areas with falls and pools.

Bear Lake:

Station #8 is located at the northwest corner of Bear Lake. This area is directly adjacent to the eastern boundary of the proposed tailings site. Preoperational monitoring of the biota will provide baseline information in assessing any effect from tailings deposition.

Other Area Rivers:

The Split Rock and Baptism Rivers are in close proximity to the Beaver River. These rivers will be sampled and used as controls to determine if an "area effect" from severe weather conditions has caused fluctuations in the stream biota. Split Rock is designated #9 and Baptism River #10, and both will be sampled above Highway #61.

Air Quality Monitoring

Reserve Mining Company started an air quality monitoring program in 1972 to evaluate the air quality in the industrial plant area and the residential area of Silver Bay. For the Mile Post 7 tailings basin, 12 stations, seven existing and five new, have been established to monitor air quality. See the following table and figure.

The results of sampling these 12 stations before the deposition of tailings begins will provide ample preoperational background data. Operation of these high volume air samplers will continue during the entire active life of the Mile Post 7 tailings disposal basin.

Air Quality Monitoring (con't)

Air Sampling Stations

RMCO Sampler Number	Site Classification	Site Location
1	Rural Residential	1-1/2 miles north of Silver Bay, Minnesota on Hwy. 61.
2	Industrial	Directly north of Reserve's Auditorium building.
3	City Residential	50 Arthur Circle, Silver Bay,. Minnesota.
4	Industrial	MP&L Hillside Substation, Silver Bay, Minnesota.
5	City Residential	293 Outer Drive, Silver Bay, Minnesota.
6	Industrial	Behind Beaver Bay Sports Shop East Beaver Bay, Minnesota.
7	City Residential	44 Hays Circle, Silver Bay, Minnesota.
8	Rural Residential	Lake County Highway No. 4, 5-1/2 miles north of Beaver Bay, Minnesota.
9	Rural Residential	West end of Lax Lake near Highway No. 4.
10	Rural	Silver Bay Country Club.
11	Rural	3.2 miles west of the intersection of County Highways 3 and 4.
12	Rural	Silver Bay Municipal Airport.

23

Air Quality Monitoring (con't)

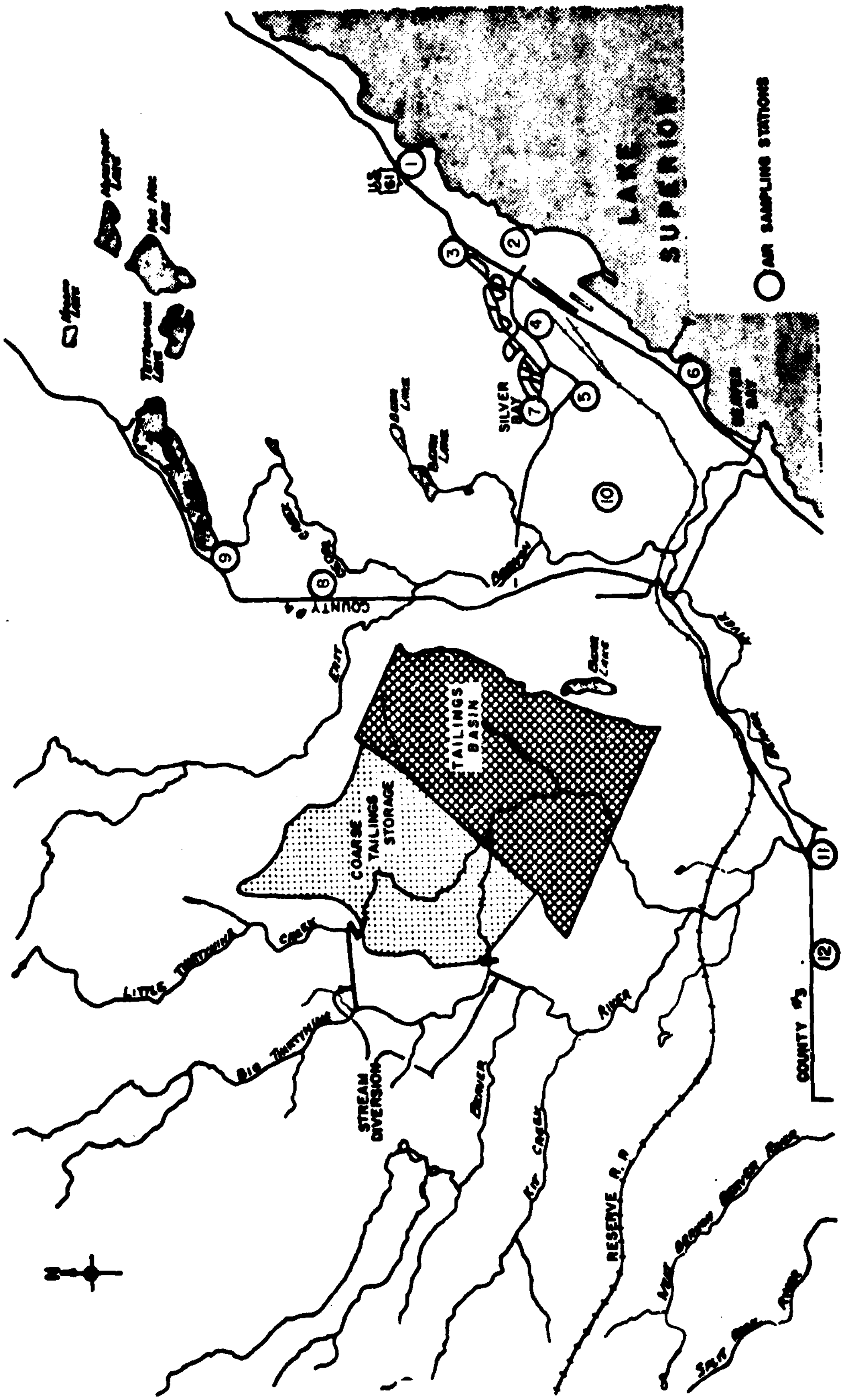


Exhibit 49

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

316 North Robert Street, St. Paul, Minnesota 55101

February 4, 1977

Mr. Robert F. Post
Chief, Environmental Resources
Branch
Engineering Division
U. S. Army Corps of Engineers
1135 U. S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Mr. Post:

Enclosed is an inventory and evaluation of the sites that you requested for determination of potential prime and unique agricultural lands. This was prepared by Herbert R. Boe, District Conservationist at Duluth and contains all the information that we have at the present time on these sites.

As you will notice, there is potential acreage of prime farm land only on one site - Milepost 7.

I would also like to clarify that prime farm land is determined by land classification, not by the crops on it and the 795 acres that are potential prime farm land in Milepost 7 are, in reality, prime forest land.

If we can be of further assistance to you, please feel free to contact us.

Sincerely,

Harry M. Major
State Conservationist

Enclosures

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT. CORPS OF ENGINEERS
1135 U. S. POST OFFICE & CUSTOM HOUSE
ST. PAUL. MINNESOTA 55101

IN REPLY REFER TO

NCSED-ER

23 June 1976

Mr. M. R. Banovetz
Executive Vice President
Reserve Mining Company
Silver Bay, Minnesota 55614

Dear Mr. Banovetz:

This is in reference to the applications which you submitted on behalf of Reserve Mining Company for permission to develop an on-land tailings disposal area at Mile Post 7 in Lake County, approximately 4 miles west of Silver Bay, Minnesota.

Mr. Russell W. Fridley, State Historic Preservation Officer for the Minnesota Historical Society has requested that an archaeological survey be prepared to cover both historic and prehistoric sites which may be affected by the proposed project. A copy of Mr. Fridley's letter is inclosed. Upon completion of this investigation, an archaeological report is to be submitted to the Corps of Engineers for review. Mr. Fridley may be able to help you with this matter; his telephone number is 612-296-2747.

The report should be submitted to our office at your earliest convenience. If you have any questions please call Mr. Gary Elftmann, telephone number 612-725-7977. Processing of the applications will continue, but cannot be completed until the information requested above has been provided.

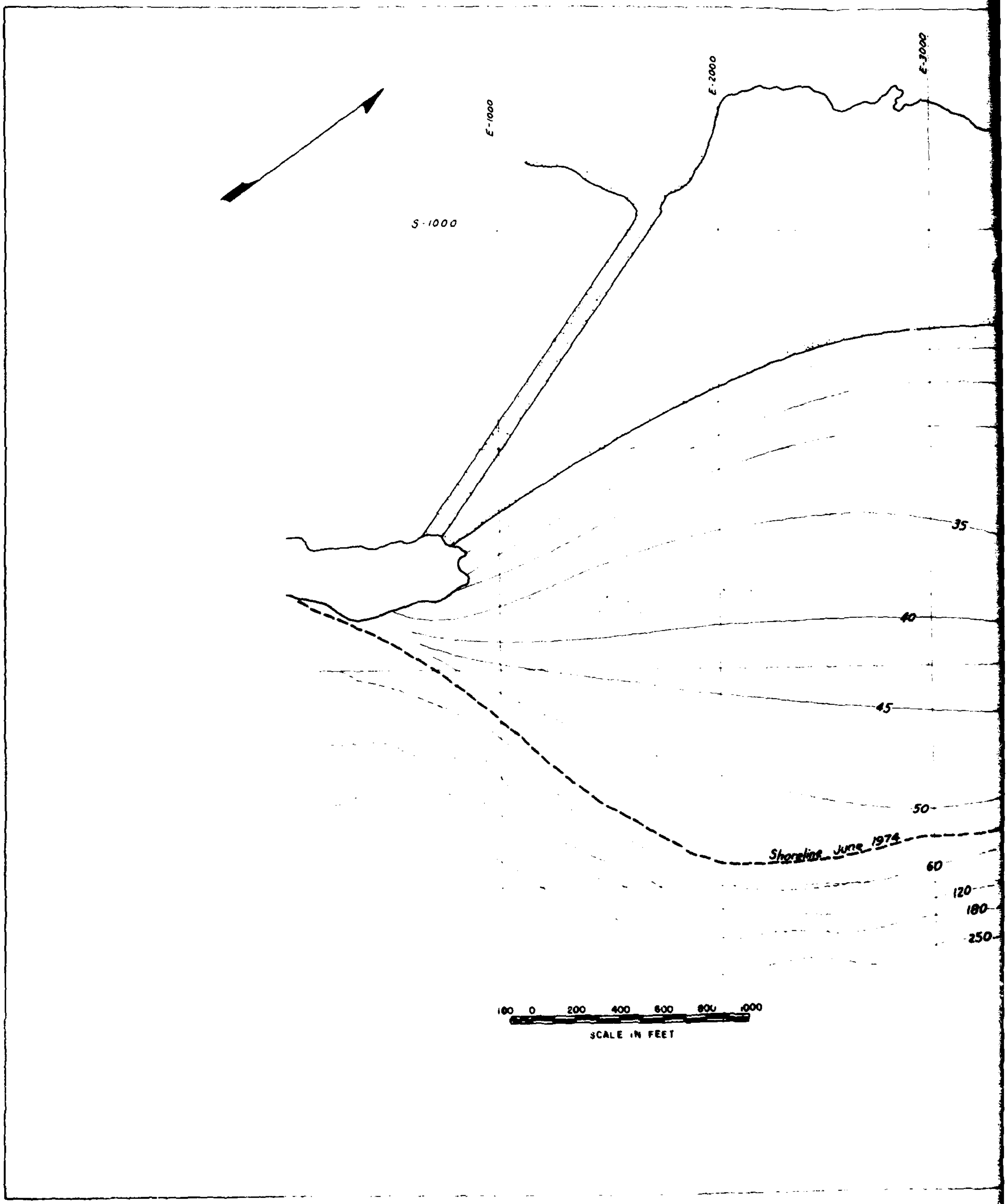
Sincerely,

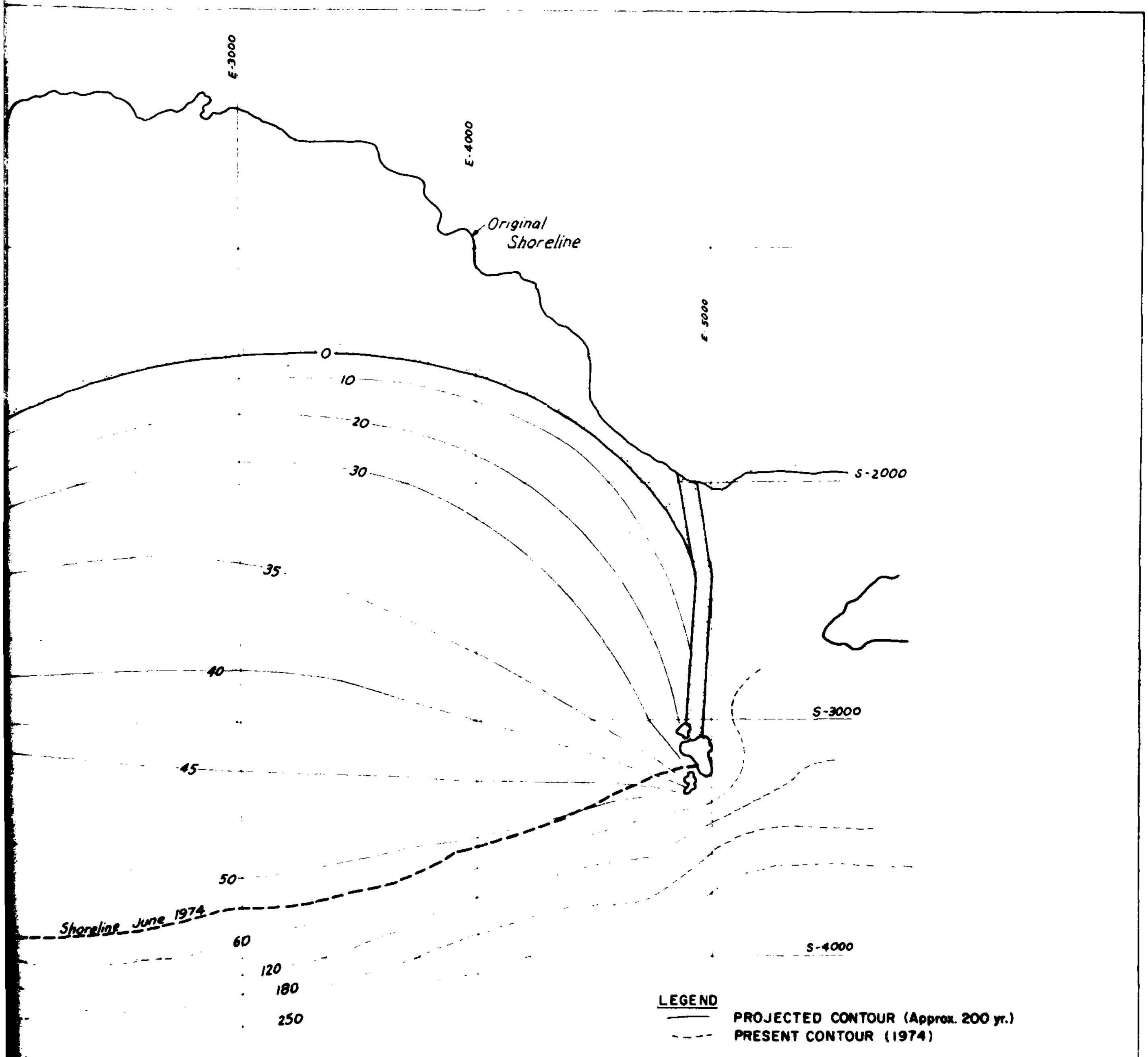
1 Incl
As stated

FORREST T. GAY, III
Colonel, Corps of Engineers
District Engineer

Copy furnished:
Mr. Russell W. Fridley
690 Cedar St.
St. Paul, Minnesota 55101

AMERICAN REVOLUTION BICENTENNIAL 1776-1976


E-1000
E-2000
E-3000
S-1000
35
40
45
50
Shoreline June 1974
60
120
180
250
100 0 200 400 600 800 1000
SCALE IN FEET

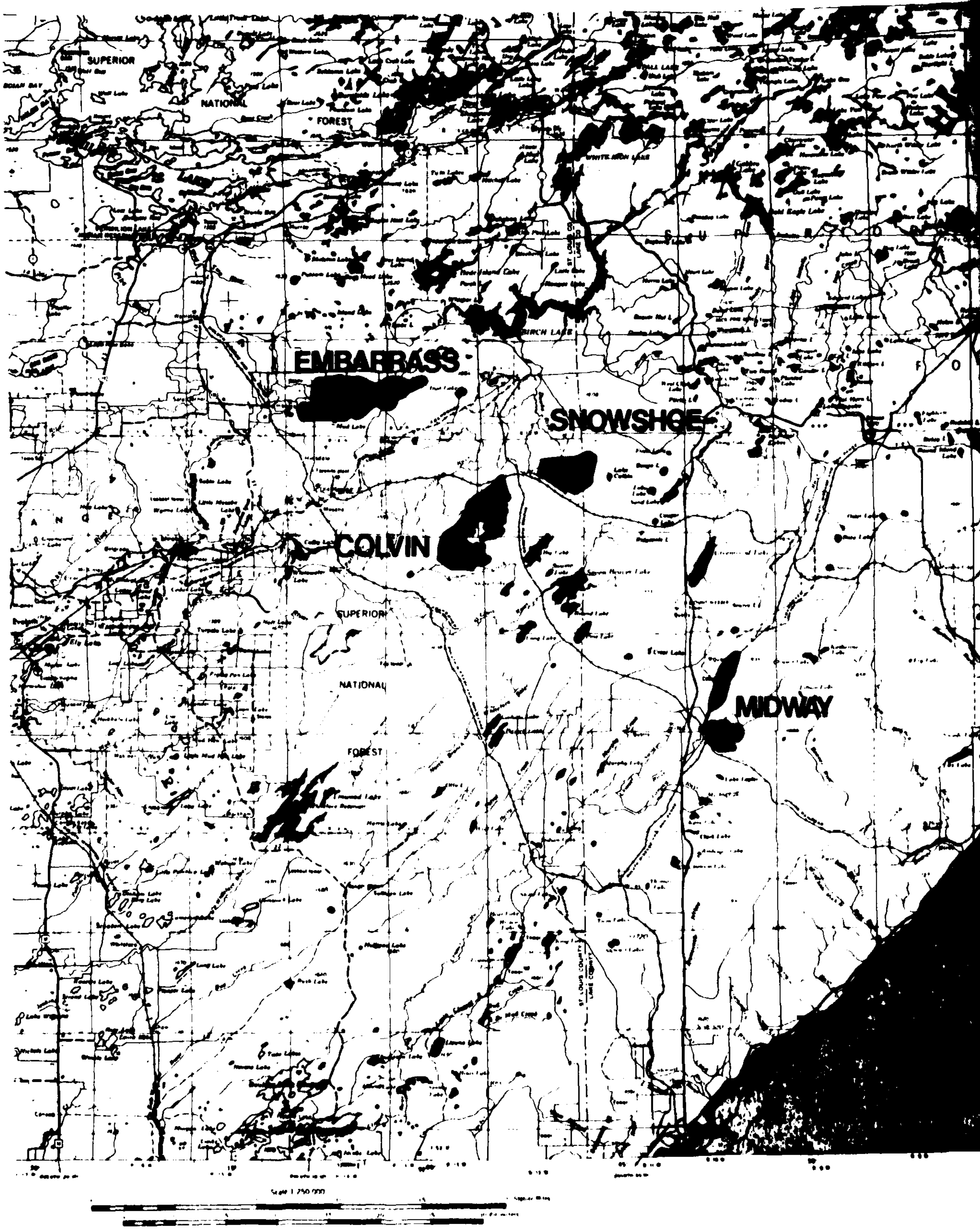


RESERVE MINING CO.
TAILINGS DELTA STABILIZATION

ULTIMATE BEACH CONFIGURATION
(NO ARMOUR)

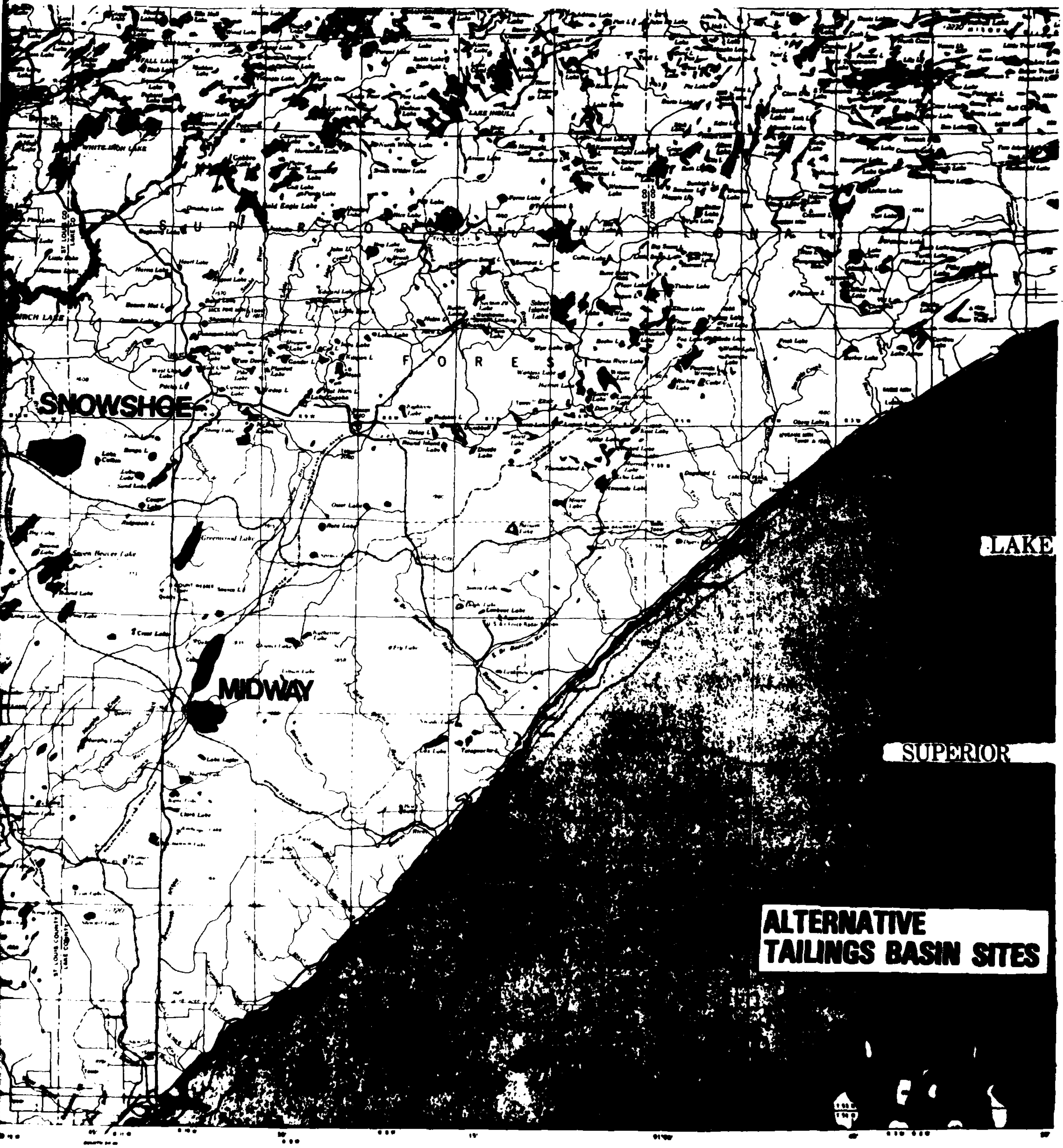
Exhibit 52

1 2



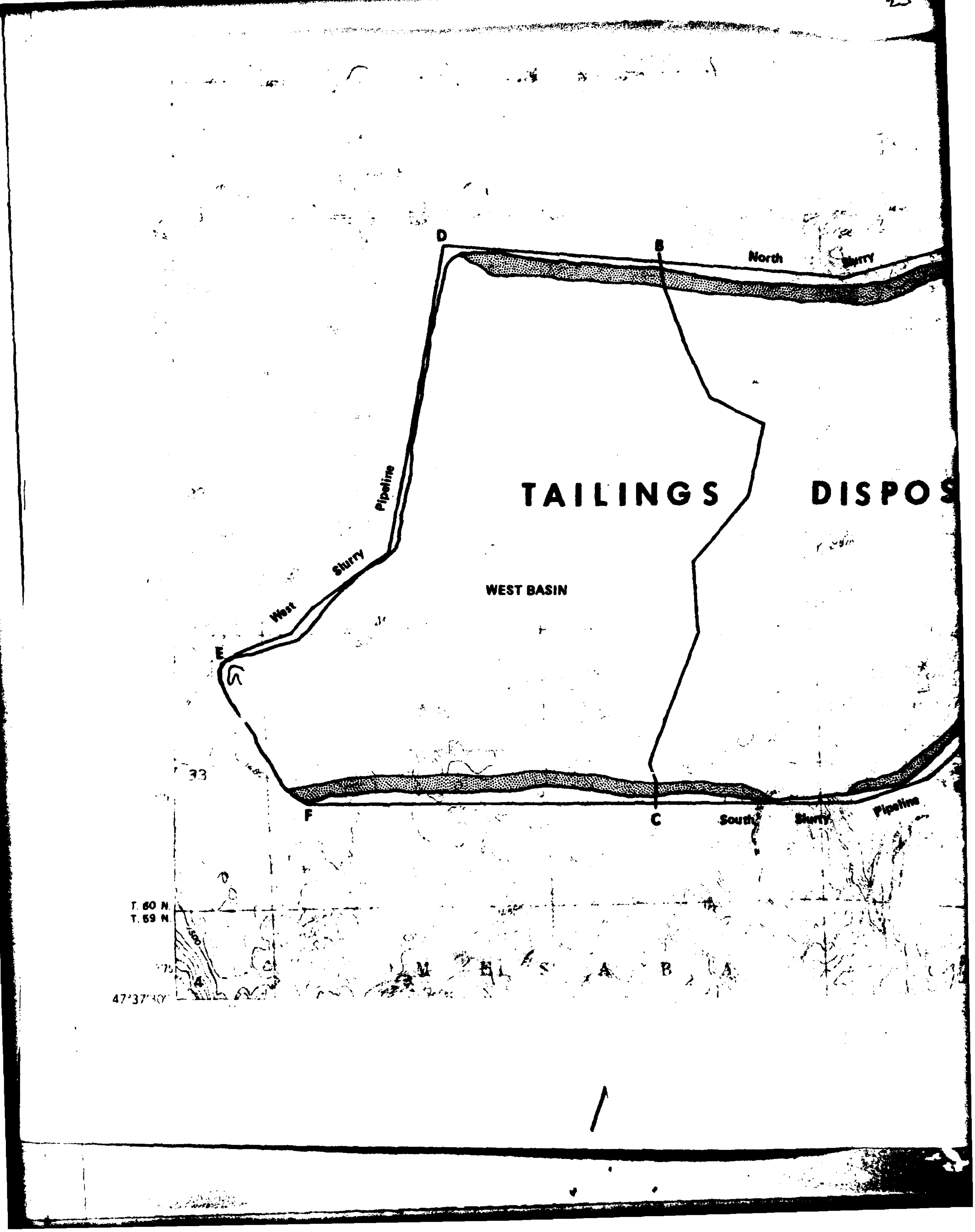
SUPERIOR
NATIONAL
FOREST
EMBARRASS
SNOWSHOE
COLVIN
SUPERIOR
NATIONAL
FOREST
MIDWAY
BIRCH LAKE
WHITE IRON LAKE

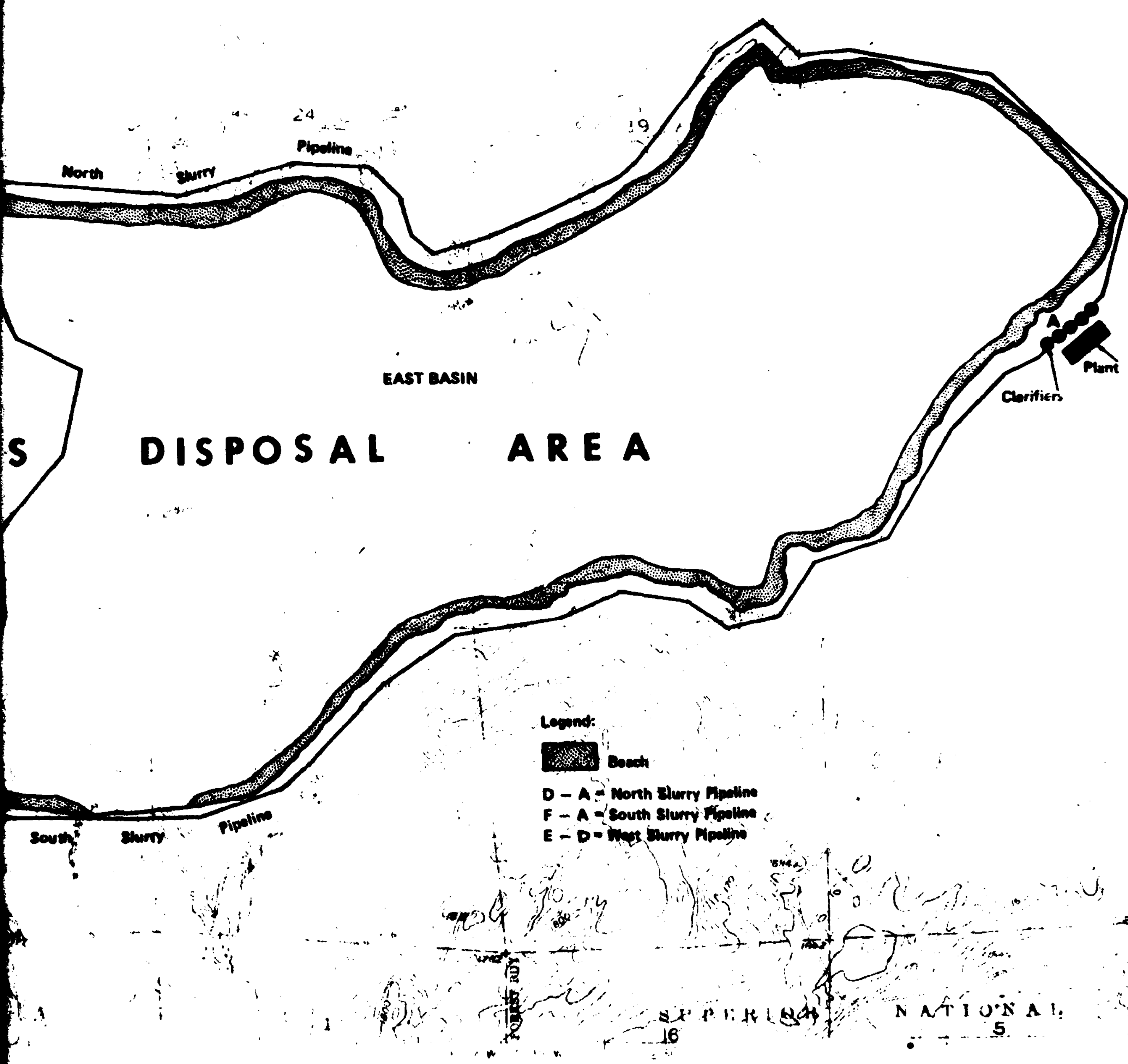
2-?



SNOWSHOE
MIDWAY
FOREST
LAKE
SUPERIOR
ALTERNATIVE
TAILINGS BASIN SITES

2 Exhibit


D
B
North Slurry
West Slurry Pipeline
TAILINGS DISPOS
WEST BASIN
E
33
F
C
South Slurry Pipeline
T. 60 N.
T. 59 N.
1500
4
47°37'30"
M E S A B A



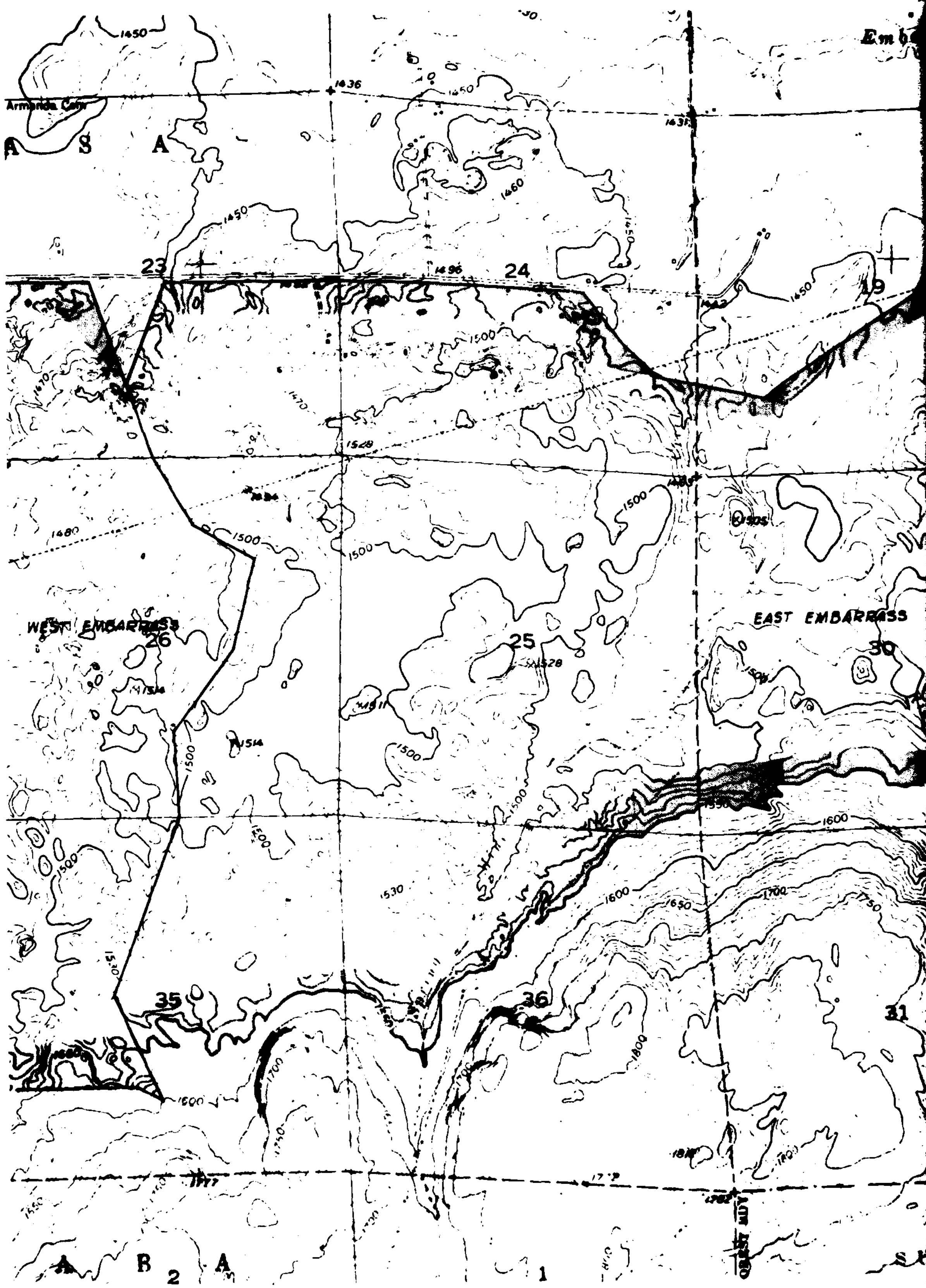
Embarrass Alternative

Arthur D Litt

Exhibit

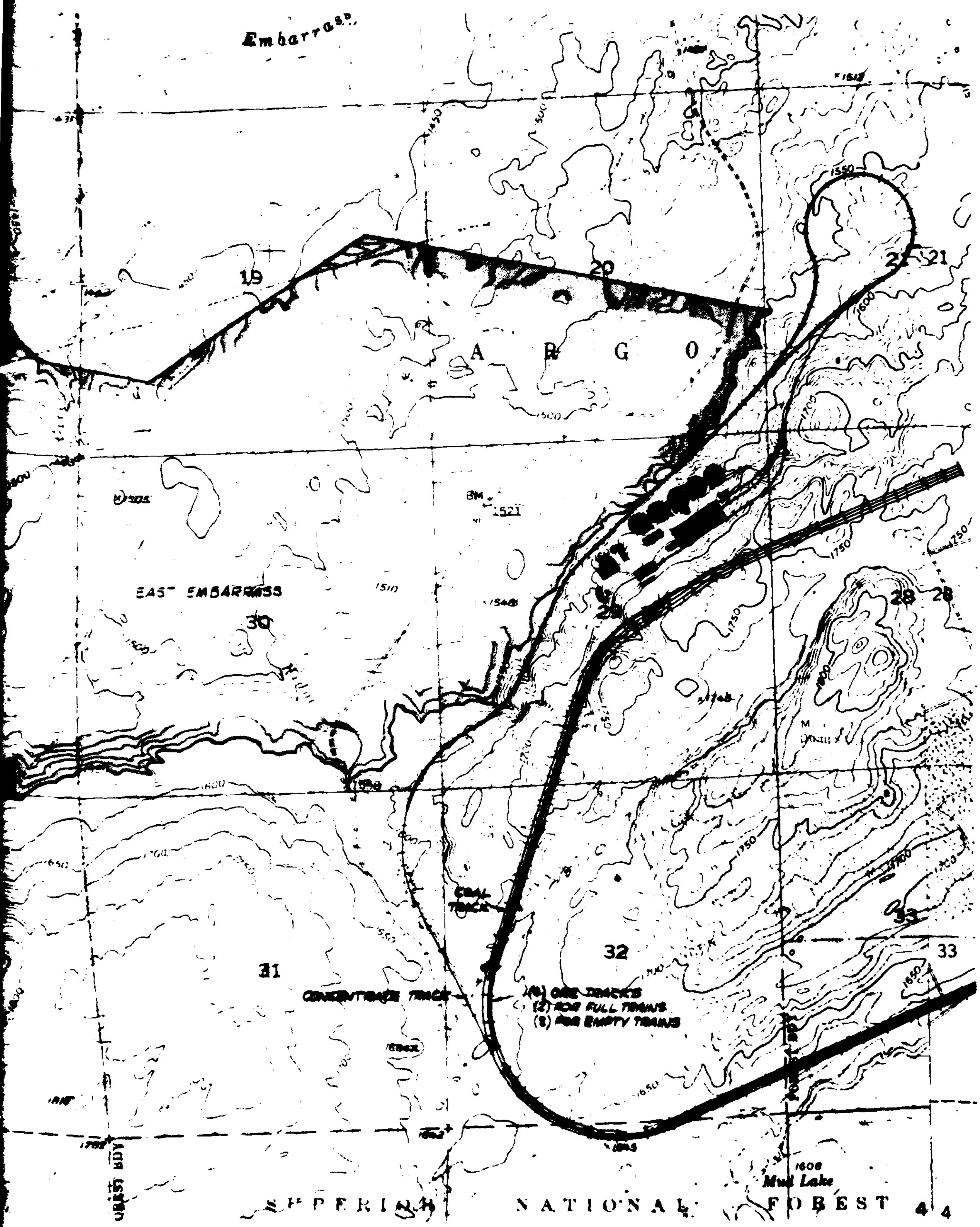
1

2



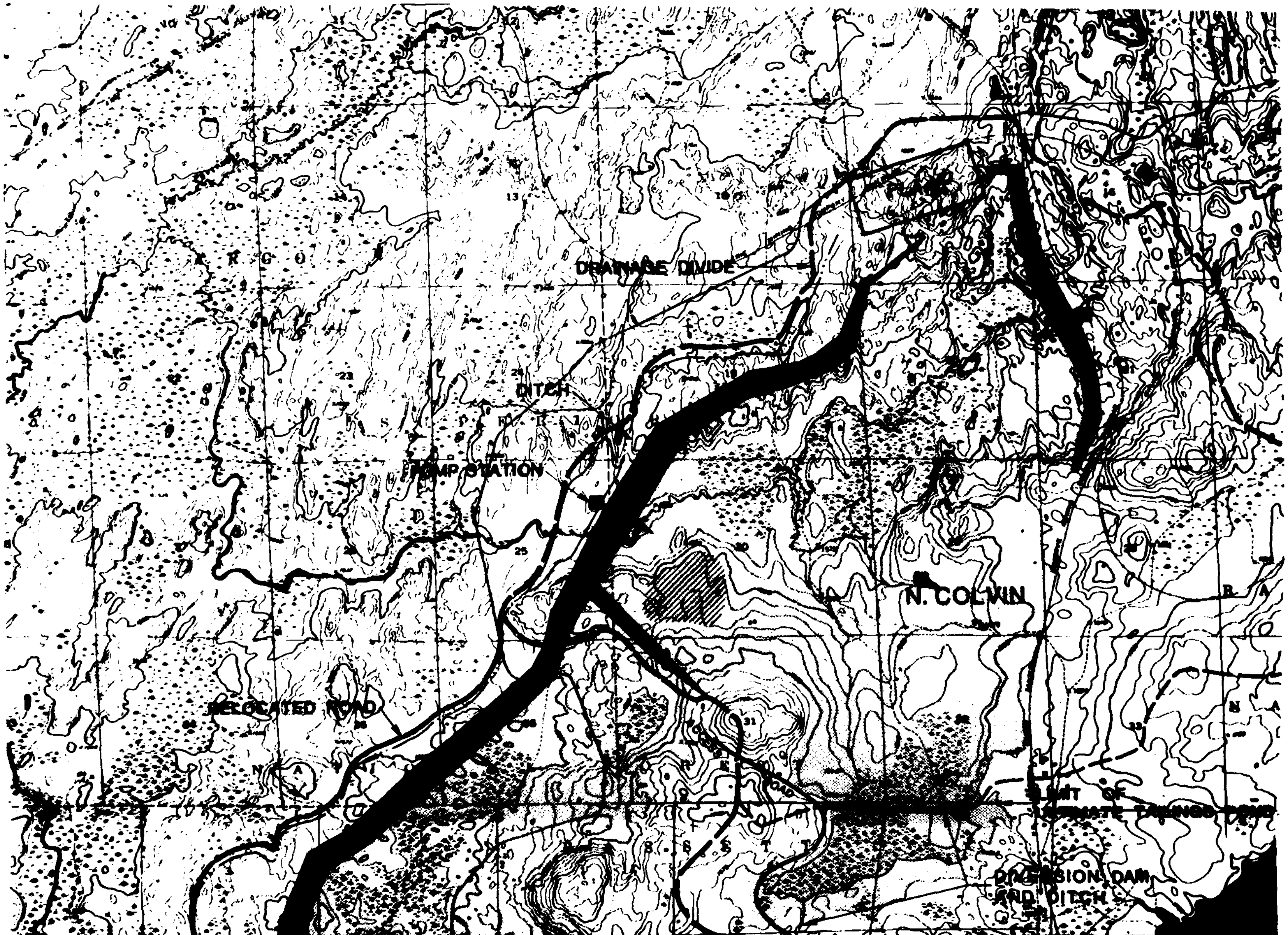
EMBARRASS ALTERNATIVE—CONCENTRAT

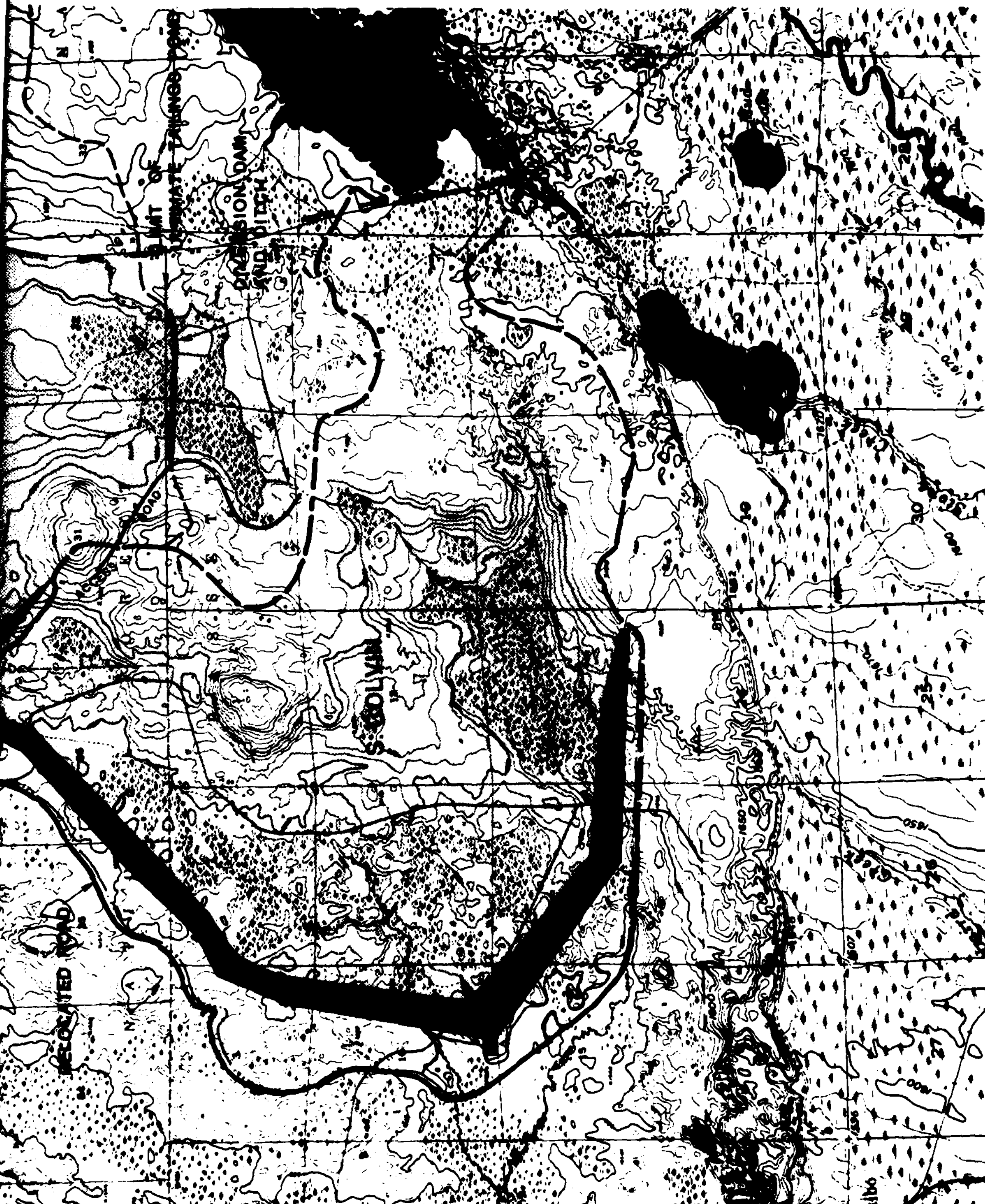
/



IVE— CONCENTRATOR AND RAIL SPUR

Exhibit 55

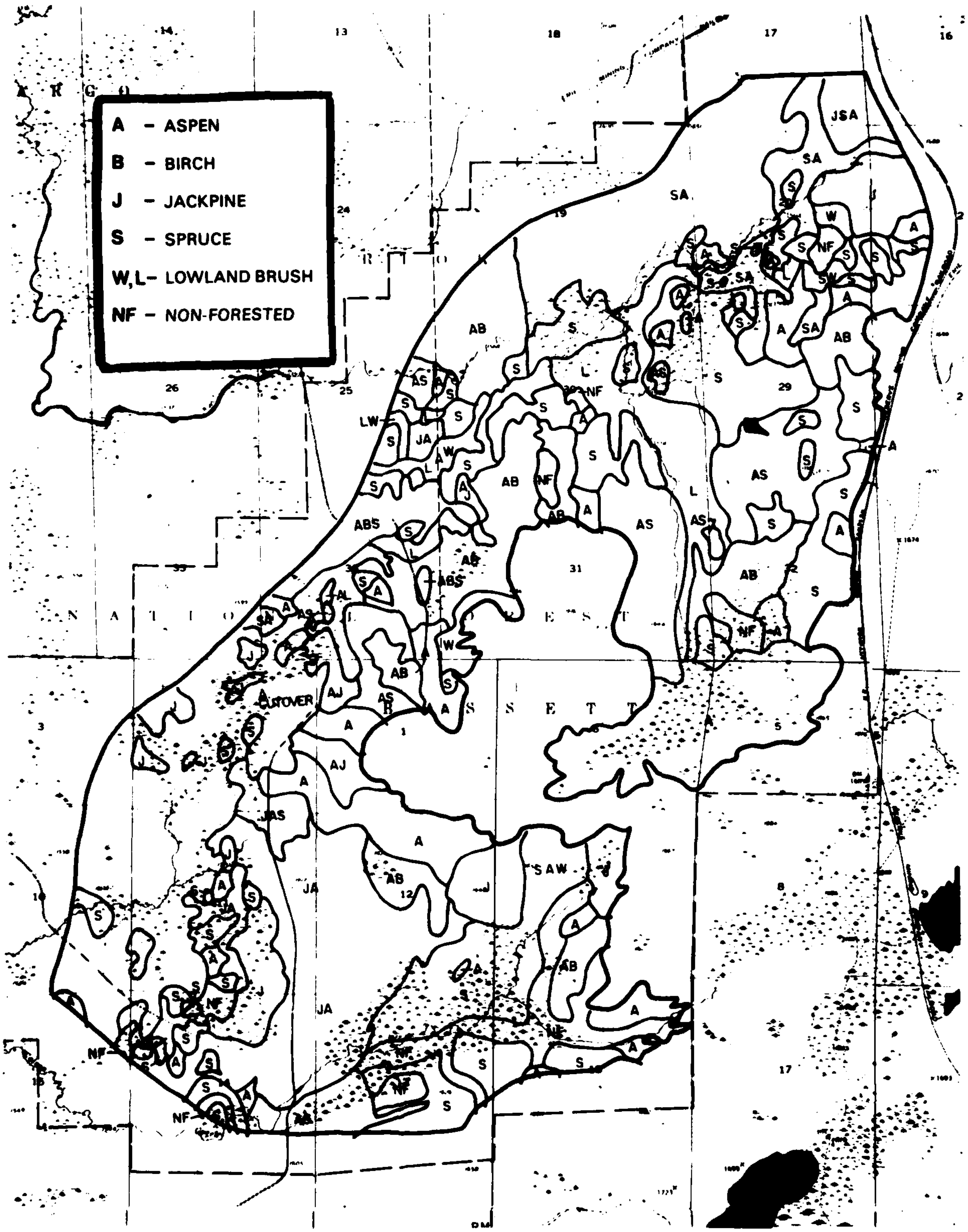

DRAINAGE DIVIDE
DITCH
PUMP STATION
N. COLWIN
RELOCATED ROAD
DIVERSION DAM
AND DITCH



COLVIN ALTERNATIVE

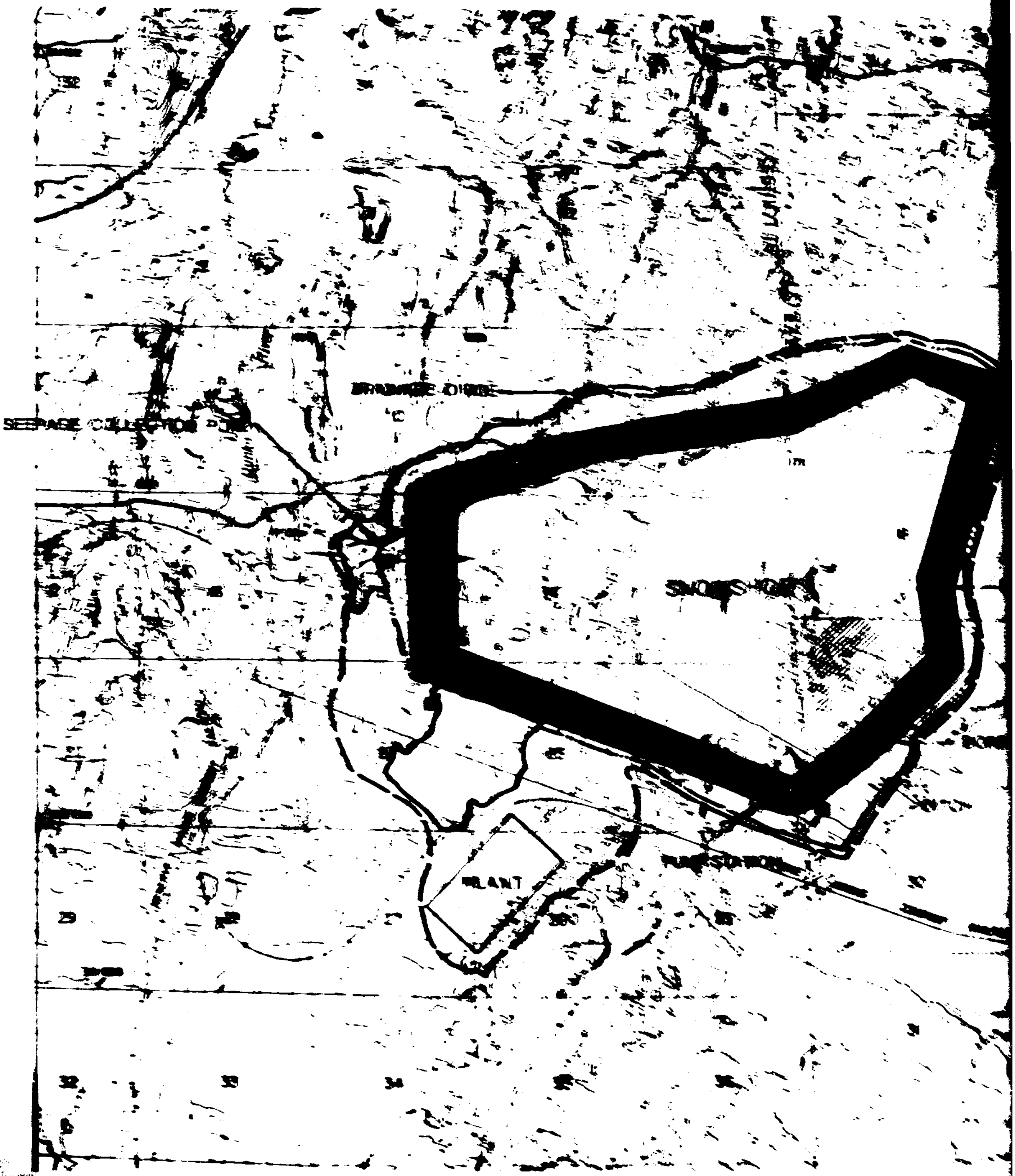
1 2

Exhibit 56



COLVIN SITE—VEGETATION TYPES

Exhibit 57


SEEPAGE
PLANT
29
32
33
34

2

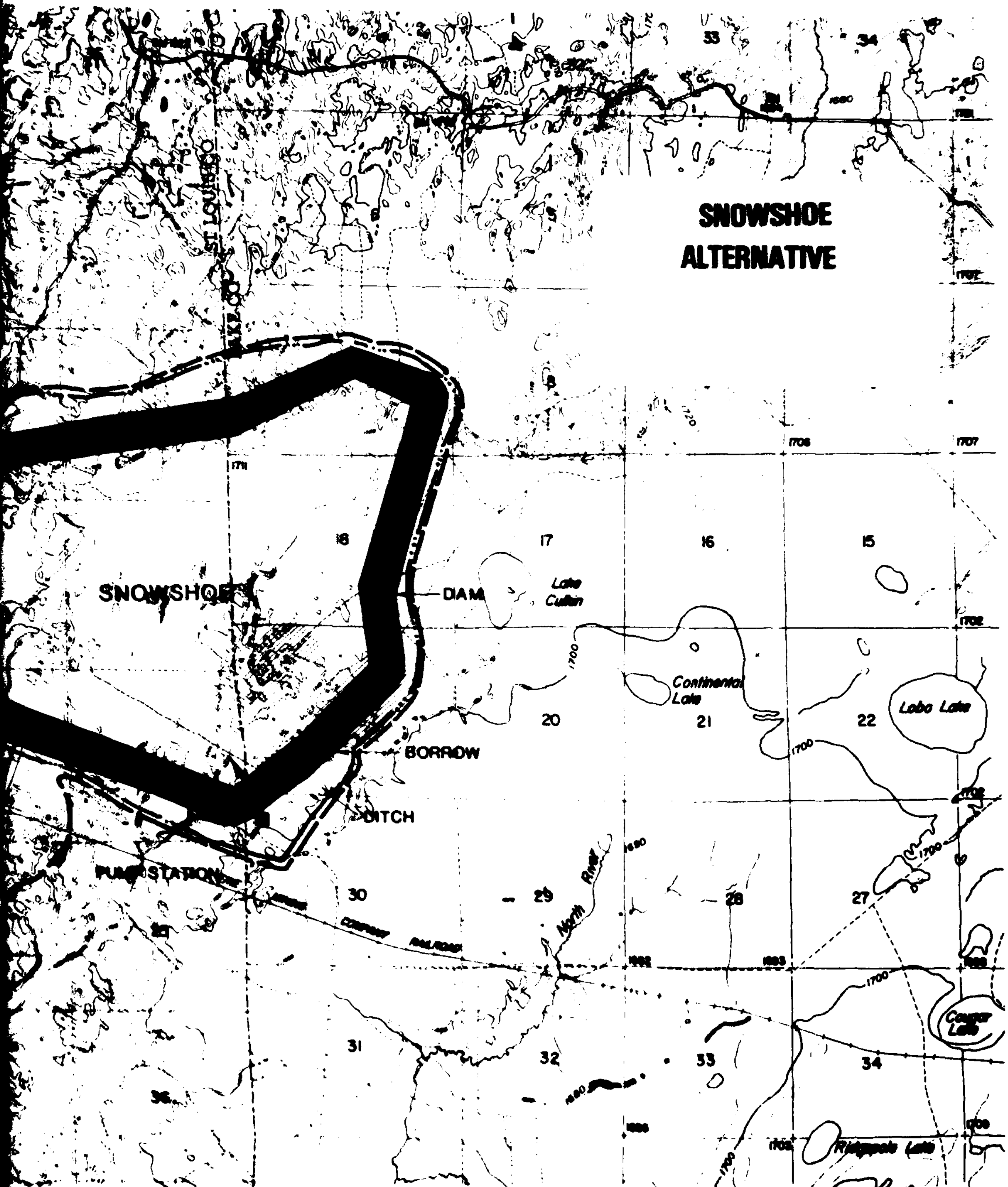
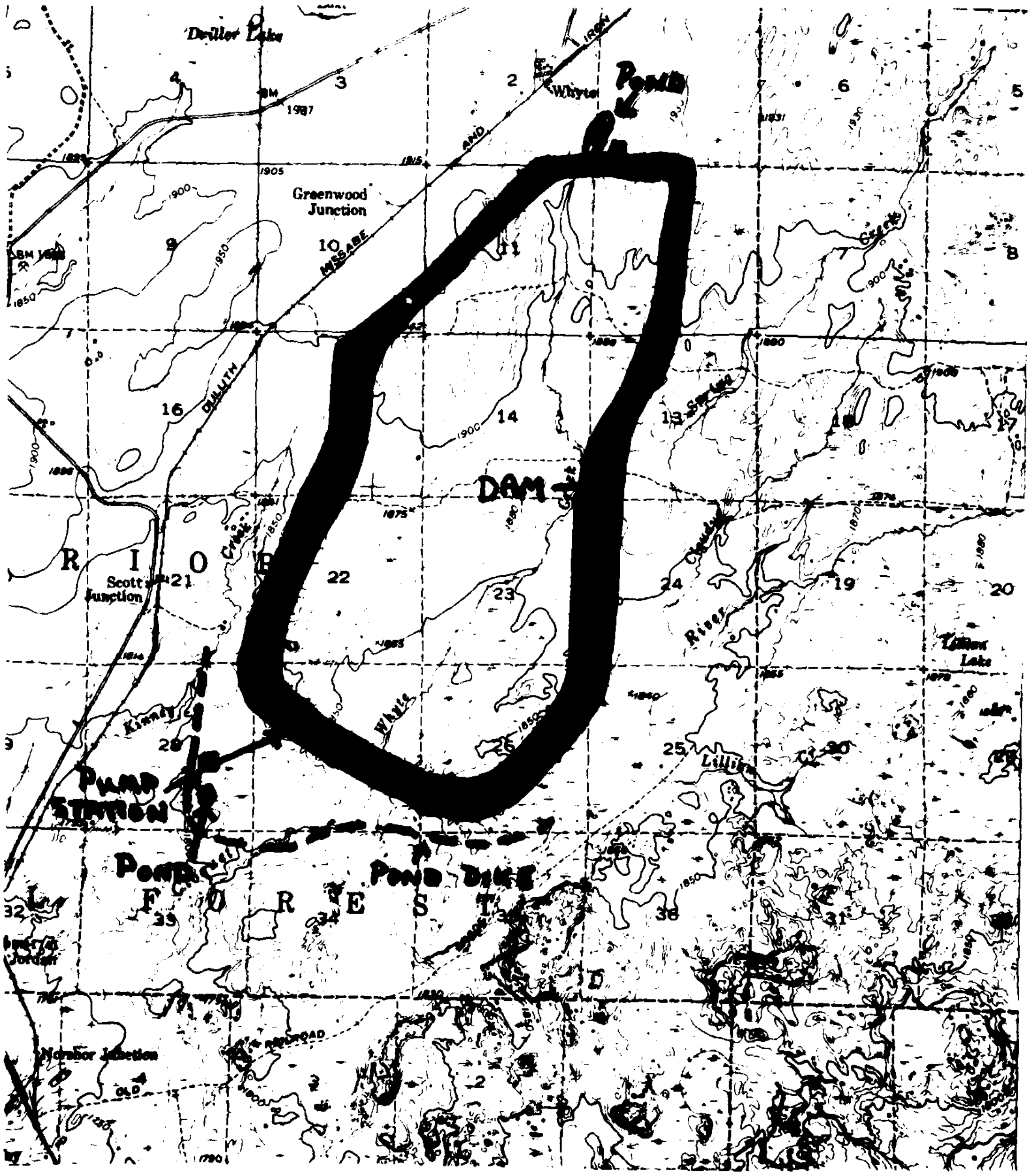

SNOWSHOE
ALTERNATIVE
33
34
8
5
18
17
16
15
SNOWSHOE
DAM
Lake Cullen
Continental Lake
20
21
22
Lobo Lake
BORROW
DITCH
PUMP STATION
30
29
28
27
North River
RAILROAD
31
32
33
34
Cougar Lake
Ridgepole Lake
1700

Exhibit 38

MIDWAY ALTERNATIVE SITE PLAN - 1976



A-79

Exhibit 59

MIDWAY SITE-VEGETATION TYPES

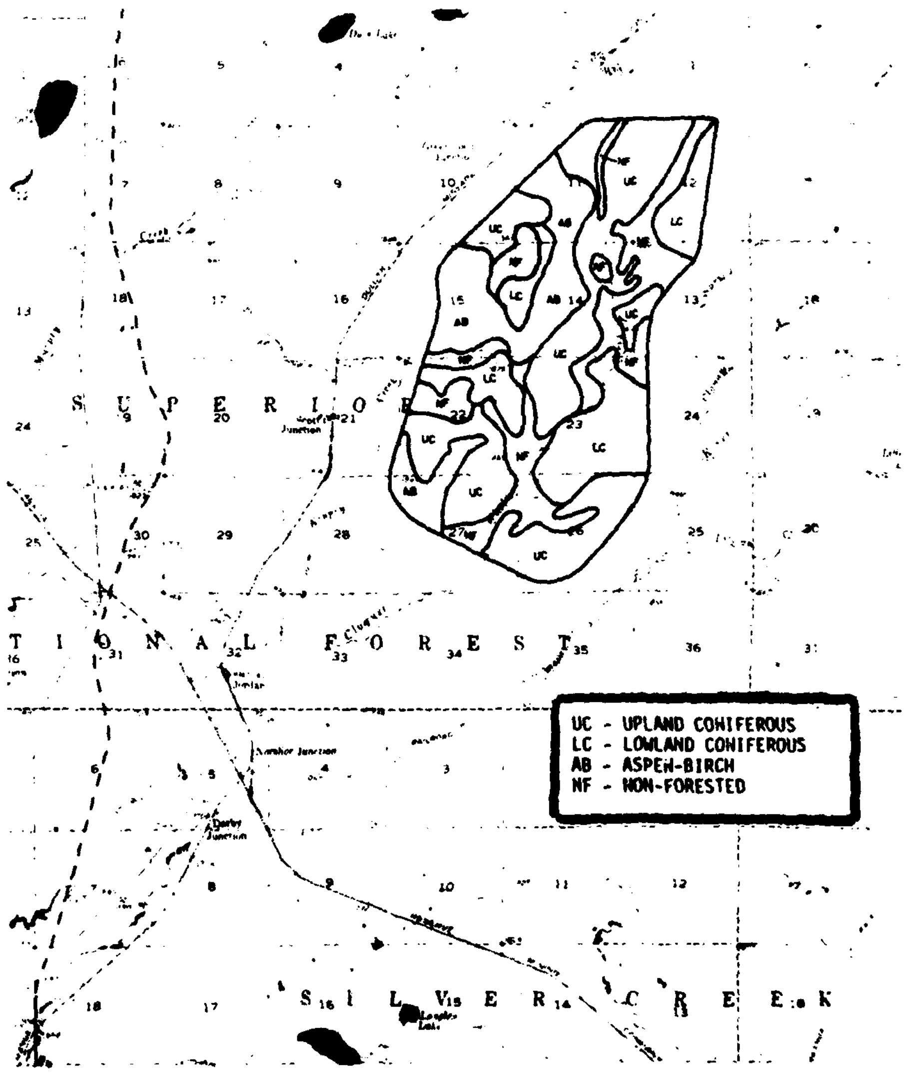
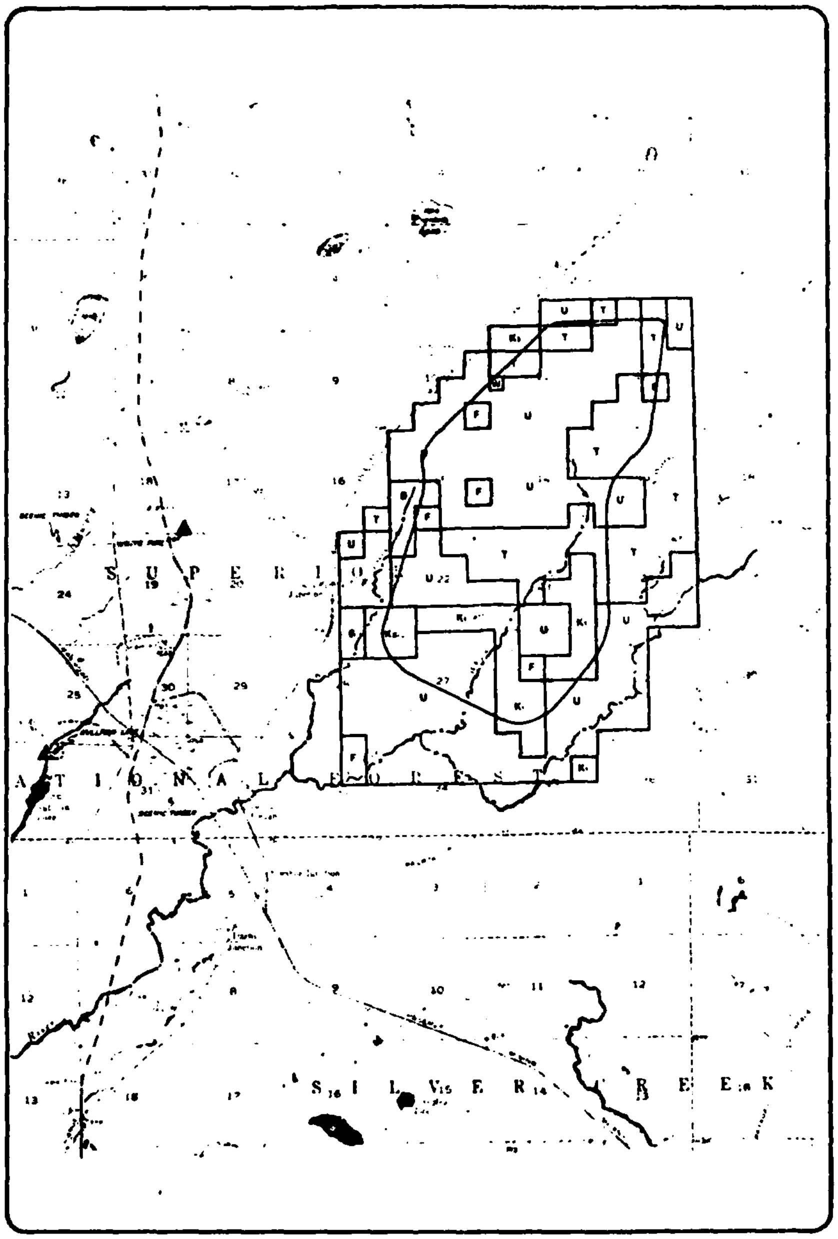


Exhibit 60



LEGEND

OWNERSHIP

U - Federal Lands
T - State Trust Fund Lands
F - Tax Forfeited Land
K1 - Kimberly Clark Corporation
K2 - Karon
K3 - Kenner
W - Wright
B - Borkon
M - Mueller
S - Siegel

MIDWAY - LAND OWNERSHIP

Exhibit 61

SECTION 404(b) EVALUATION

As part of our overall environmental review, we have conducted an evaluation of the proposed project as required under Section 404(b) of Public Law 92-500. The evaluation was conducted in accordance with Corps of Engineers regulations published in the 25 July 1975 Federal Register (33 CFR 209) and Environmental Protection Agency guidelines published in the 5 September 1975 Federal Register (40 CFR 230).

There are two distinct types of filling associated with the proposed project. First there is the placement of mine waste rock in Lake Superior to support the power plant discharge pipe and on the delta to form the stabilization dike. Second there is the many fill actions in the Beaver River watershed to facilitate the construction of the Mile Post 7 disposal site.

Attached are two lists of the Section 404 evaluation factors and the places where they are addressed in the final EIS for each of the two types of actions described above. If an evaluation factor is not addressed in the final EIS, an explanatory statement is added.

Exhibit 62

SECTION 404 EVALUATION FACTORS DERIVED FROM
40 CFR 230.3 - 230.5 and 33 CFR 209.145 (e-g)

MINE ROCK SUPPORT FOR DISCHARGE PIPE AND DELTA STABILIZATION DIKE

I. Physical Effects (40 CFR 230.4-1 (a)).

A. Potential destruction of wetlands-effects on: (40 CFR 203.4-1 (a) (1) (i-vi)).

The proposed fills would have no impact or potential for impact upon wetlands.

B. Impact on water column (40 CFR 230.4-1 (a) (2)).

The proposed fills would have no physical impact upon the water column, save for the displacement of a like volume of water.

C. Covering of benthic communities (40 CFR 230.4-1 (a) (3)).

1. Actual covering of benthic communities.

Addressed in paragraph 4.006 page 53 of the final EIS.

2. Changes in community structure or function.

Addressed in paragraph 4.008 page 54 of the final EIS.

D. Other effects (40 CFR 230.4-1 (a)).

1. Changes in bottom geometry and substrate composition.

Addressed in paragraph 4.008 page 54 of the final EIS.

The proposed mine rock fills should have no other physical effects.

II. Chemical - Biological Interactive Effects (40 CFR 230.4-1 (b)).

As the mine rock is essentially chemically inactive, save for the slow process of water erosion of the rock, there should be no chemical - biological interactive effects associated with the proposed fills.

III. Review State Water Quality Standards (40 CFR 230.4-2).

State water Quality Standards are reviewed in paragraphs 4.069-4.070 pages 63-65 of the final EIS.

Exhibit 62

23

IV. Selection of Disposal Sites (40 CFR 230.5).

A. Impacts of fill on chemical, physical and biological integrity of aquatic ecosystem (40 CFR 230.5 (a) 1-8)).

1. Impact on food chain.

Addressed in paragraph 4.008 page 54 of the final EIS.

2. Impact on diversity of plant and animal species.

Addressed in paragraph 4.008 page 54 of the final EIS.

3. Impact on movement into and out of feeding, spawning, breeding and nursery areas.

The proposed fills would have no impact upon movements of aquatic organisms in and out of feeding, spawning, breeding and nursery areas.

4. Impact on wetland areas having significant functions of water quality maintenance.

The proposed fills would have no impacts upon wetlands.

5. Impact on areas that serve to retain natural high waters or flood waters.

The proposed fills would have no impact in this area.

6. Methods to minimize turbidity.

Addressed in paragraphs 4.005-4.006 page 53 of the final EIS.

7. Methods to minimize degradation of aesthetic, recreational and economic values.

The proposed fills would have no impact in these areas, save the cost to the permit applicant. It is believed that the applicant would minimize their costs to the best of their ability.

8. Investigate other measures that avoid degradation of water quality.

As the proposed fills would have little or no degradation of water quality associated with them, we have not been able to discover any further measures to avoid this minor degradation.

B. Impacts on water uses at proposed fill site (40 CFR 230.5 (b) (1-10)).

1. Municipal water supply intakes.

There are no municipal water supply intakes in proximity to the proposed fills. However, the purpose of the delta stabilization dike is to minimize water supply degradation on a regional basis. (See paragraphs 4.025-4.030 pages 56-57 of the final EIS.)

2. Shellfish.

The proposed fills would have no impact upon shellfish.

3. Fisheries (including mitigation - 33 CFR 209.145 (e) (4)).

Addressed in paragraph 4.013 page 54 of the final EIS.

4. Wildlife (including mitigation - 33 CFR 209.145 (e) (4)).

The proposed fills would have no impact upon wildlife.

5. Recreation activities.

The proposed fills would have no impact upon recreation.

6. Threatened and endangered species.

The proposed fills would have no impact on threatened and endangered species.

7. Benthic life.

Addressed in paragraphs 4.006, 4.008 pages 53-54 of the final EIS.

8. Wetlands.

The proposed fills would have no impact upon wetlands.

9. Submersed vegetation.

The proposed fills would have no impact on submersed vegetation.

10. Size of disposal site.

The sizes of the proposed fills are given in paragraph 1.139 and paragraph 1.142 page 29 of the final EIS. These are the minimum sizes necessary to accomplish the purposes of the fills.

11. Cultural resources, scenic and conservation values (33 CFR 209.145 (e) (5)).

The proposed fills would have no impact upon cultural resources or areas with unique scenic or conservation values.

Exhibit 62

12. Coastal Zone Management programs.

Addressed in paragraph 3.005 page 52 of the final EIS.

C. Considerations to minimize harmful effects (40 CFR 230.5 (e) (2,3,5-7)).

1. Investigate alternatives to open water disposal.

There are no alternatives to open water disposal for the proposed fills; i.e., they must be placed in Lake Superior to serve their function.

2. Investigate physical characteristics of alternative disposal sites.

See response to (1), above.

3. Where possible, investigate covering contaminated dredged material with cleaner material.

The proposed fills do not involve contaminated dredged material.

4. Investigate methods to minimize effect of runoff from confined areas on the aquatic environment.

Addressed in paragraph 4.005 page 53 of the final EIS.

5. Investigate monitoring activities of disposal site.

Addressed in paragraph 4.005 page 53 of the final EIS.

D. Discuss quality of fill material.

Addressed in paragraph 4.006 page 53 of the final EIS.

E. Discuss mixing zone determinations.

The physical nature of the fill material (rock) is such that there would be no mixing zone.

F. Discuss navigation impacts (33 CFR 209.145 (e) (1) (ii)).

The proposed fills would have no impact upon navigation.

V. Public Participation and Coodination (33 CFR 209.145 (f and g)).

Addressed in paragraphs 9.001-9.013 pages 148-149 of the final EIS.

Exhibit 62

SECTION 404 EVALUATION FACTORS DERIVED FROM
40 CFR 230.3 - 230.5 and 33 CFR 209.145 (e-g)

MILE POST 7 PROPOSAL

I. Physical Effects (40 CFR 230.4-1 (a)).

A. Potential destruction of wetlands-effects on: (40 CFR 203.4-1 (a) (1) (i-vi)).

1. Food chain production.

Addressed in paragraphs 4.045-4.046 page 59 of the final EIS.

2. General habitat.

Addressed in paragraphs 4.045-4.046 page 59 of the final EIS.

3. Nesting, spawning, rearing and nesting sites for aquatic or land species.

Addressed in paragraphs 4.045-4.046 page 59 of the final EIS.

4. Those set aside for aquatic environment study, sanctuaries, or refuges.

No areas set aside for aquatic environment study, sanctuaries, or refuges would be affected by the Mile Post 7 proposal.

5. Natural drainage characteristics.

Addressed in paragraph 4.047 page 60 of the final EIS.

6. Sedimentation Patterns.

7. Salinity Distribution.

8. Flushing Characteristics.

9. Current Patterns.

10. Wave action, erosion, or storm damage protection.

Evaluation factors 6 - 10 primarily apply to coastal wetlands. The wetlands involved in the proposed action are inland wetlands.

11. Storage areas for storm and flood waters.

Addressed in paragraphs 4.046-4.047 pages 59-60 of the final EIS.

Exhibit 62

12. Prime natural recharge areas.

The proposed wetland filling would not affect any prime natural recharge areas. The wetlands involved are discharge areas.

13. Cumulative effects of alterations, (33 CFR 209.145 (3) (iii)).

Addressed in paragraph 4.048 page 60 of the final EIS.

B. Impact on water column (40 CFR 230.4-1 (a) (2)).

1. Reduction in light transmission.

Addressed in paragraph 4.054 page 61 of the final EIS.

2. Aesthetic values.

Addressed in paragraphs 4.113-4.115 page 76 of the final EIS.

3. Direct destructive effects on nektonic and planktonic populations.

Addressed in paragraph 4.059 page 61 of the final EIS.

C. Covering of benthic communities (40 CFR 230.4-1 (a) (3)).

1. Actual covering of benthic communities.

Addressed in paragraph 4.054 page 61 and paragraph 4.059 page 61 of the final EIS.

2. Changes in community structure or function.

Addressed in paragraph 4.071 page 65 of the final EIS.

D. Other effects (40 CFR 230.4-1 (a)).

1. Changes in bottom geometry and substrate composition.

Addressed in paragraph 4.071 page 65 of the final EIS.

2. Water circulation

Addressed in paragraphs 4.062-4.063 page 62 of the final EIS.

Exhibit 62

II. Chemical - Biological Interactive Effects (40 CFR 230.4-1 (b)).

A. Water column effects of chemical constituents (40 CFR 230.4-1 (b) (2)).

Addressed in paragraph 4.066 page 62 of the final EIS.

B. Effects of chemical constituents on benthos (40 CFR 230.4-1 (b) (3)).

Addressed in paragraph 4.066 page 62 of the final EIS.

III. Review State Water Quality Standards (40 CFR 230.4-2).

Reviewed in paragraphs 4.069-4.070 pages 63-65 of the final EIS.

IV. Selection of Disposal Sites (40 CFR 230.5).

A. Impacts of fill on chemical, physical and biological integrity of aquatic ecosystem (40 CFR 230.5 (a) 1-8)).

1. Impact on food chain.

Addressed in paragraph 4.054 page 61 of the final EIS.

2. Impact on diversity of plant and animal species.

Addressed in paragraph 4.059 page 61 of the final EIS.

3. Impact on movement into and out of feeding, spawning, breeding and nursery areas.

Addressed in paragraph 4.055 page 61 of the final EIS.

4. Impact on wetland areas having significant functions of water quality maintenance.

The proposal should have no impact upon wetlands having significant functions of water quality maintenance.

5. Impact on areas that serve to retain natural high waters or flood waters.

Addressed in paragraph 4.046 page 59 of the final EIS.

6. Methods to minimize turbidity.

Addressed in paragraph 4.072 page 65 of the final EIS.

Exhibit 62

7. Methods to minimize degradation of aesthetic, recreational and economic values.

Addressed in paragraph 4.072 page 65 of the final EIS.

8. Investigate other measures that avoid degradation of water quality.

Addressed in paragraph 4.072 page 65 of the final EIS.

B. Impacts on water uses at proposed fill site (40 CFR 230.5 (b) (1-10)).

1. Municipal water supply intakes.

There are no municipal water supply intakes in the area of the proposed fill site. However, the project as a whole would have an impact on municipal water supplies (paragraph 4.025 page 56 of the final EIS).

2. Shellfish

There are no shellfish beds in the project area.

3. Fisheries (including mitigation - 33 CFR 209.145 (e) (4)).

Addressed in paragraphs 4.053-4.072 pages 61-65 of the final EIS.

4. Wildlife (including mitigation - 33 CFR 209.145 (e) (4)).

Addressed in paragraphs 4.036-4.049 pages 58-60 of the final EIS.

5. Recreation activities.

Addressed in paragraphs 4.108-4.112 pages 75-76 of the final EIS.

6. Threatened and endangered species.

Addressed in paragraph 4.050 page 60 of the final EIS.

7. Benthic life.

Addressed in paragraphs 4.054-4.059 page 61 and paragraph 4.071 page 65 of the final EIS.

8. Wetlands

Addressed in paragraphs 4.045-4.049 pages 59-60 of the final EIS.

Exhibit 62

9. Submersed vegetation.

Addressed in paragraph 4.059 page 6? of the final EIS.

10. Size of disposal site.

Addressed in paragraphs 1.046-1.136 pages 11-28 of the final EIS.

11. Cultural resources, scenic and conservation values (33 CFR 209.145 (e) (5)).

Addressed in paragraphs 4.136-4.138 pages 80 81 and paragraphs 4.113-4.115 page 76 of the final EIS.

12. Coastal Zone Management programs.

Addressed in paragraph 3.005 page 52 of the final EIS.

C. Considerations to minimize harmful effects (40 CFR 230.5 (e) (2,3, 5-7)).

1. Investigate alternatives to open water disposal.

Because of the size and the nature of the project, open water disposal cannot be avoided completely.

2. Investigate physical characteristics of alternative disposal sites.

Physical characteristics of the alternative disposal sites are given in paragraphs 6.066-6.083 pages 96-99, paragraphs 6.125-6.150 pages 109-113, paragraphs 6.188-6.204 pages 120-122, and paragraphs 6.236-6.266 pages 129-133 of the final EIS.

3. Where possible, investigate covering contaminated dredged material with cleaner material.

The proposal does not involve the disposal of contaminated dredged material.

4. Investigate methods to minimize effect of runoff from confined areas on the aquatic environment.

Addressed in paragraph 4.072 page 65 of the final EIS.

5. Investigate monitoring activities of disposal site.

Discussed in paragraph 4.067 page 62, paragraph 4.072 page 65, and paragraph 4.099 page 73 of the final EIS.

D. Discuss quality of fill material.

Discussed in paragraphs 1.061-1.064 page 14, paragraph 1.078 page 17 and paragraphs 1.[illegible] 1.110 page 23 of the final EIS.

E. Discuss mixing zone determinations.

The nature of the project is such that mixing zones determinations are not applicable.

F. Discuss navigation impacts (33 CFR 209.145 (e) (1) (ii)).

The proposal would have no impact upon navigation other than maintenance of the status quo relative to Reserve's shipping of iron ore pellets.

V. Public Participation and Coordination (33 CFR 209.145 (f and g)).

Addressed in paragraphs 9.001-9.013 pages 148-149 of the final EIS.

Exhibit 62